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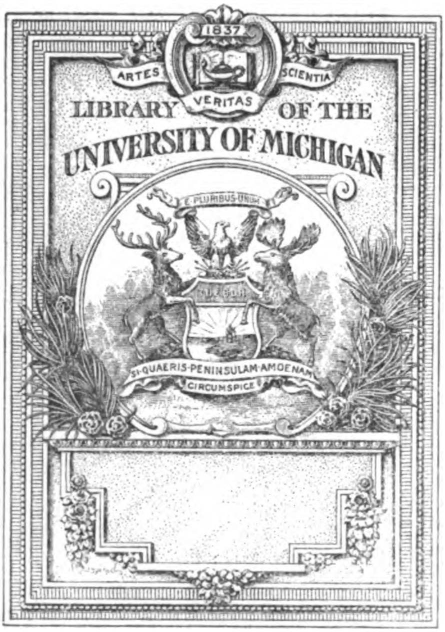
Annual Report

New York (State) Dept. of Agriculture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STATE OF NEW YORK—DEPARTMENT OF AGRICULTURE

BUREAU
OF
FARMERS' INSTITUTES

REPORT FOR YEAR 1900

C. A. WIETING . . . . *Commissioner of Agriculture*
F. E. DAWLEY . . . . *Director of Institutes*

TRANSMITTED TO THE LEGISLATURE, JANUARY 9, 1901.

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List of Farmers' Institutes for 1900.

Place.	County.	Date.
Fair Haven	Cayuga	Jan. 2–3
Richfield Springs	Otsego	Jan. 3–4
Ira	Cayuga	Jan. 4
Wolcott	Wayne	Jan. 5–6
Leonardsville	Madison	Jan. 5–6
Sodus	Wayne	Jan. 8–9
South New Berlin	Chenango	Jan. 8–9
Lincoln	Wayne	Jan. 10
Fly Creek	Otsego	Jan. 10–11
Webster	Monroe	Jan. 11–12
Schenevus	Otsego	Jan. 12
Portlandville	Otsego	Jan. 12–13
Hilton	Monroe	Jan. 13
Lyndonville	Orleans	Jan. 13
Ransomville	Niagara	Jan. 15–16
Cherry Valley	Otsego	Jan. 15–16
Carlisle	Schoharie	Jan. 16
Spencerport	Monroe	Jan. 17–18
Verdoy	Albany	Jan. 18
Esperance	Schoharie	Jan. 18
Colonie	Albany	Jan. 18
Bethlehem Centre	Albany	Jan. 19–20
Marilla	Erie	Jan. 19–20
West Sand Lake	Rensselaer	Jan. 19–20
Quaker Street	Schenectady	Jan. 19–20
Riverhead	Suffolk	Jan. 22–23
Batavia	Genesee	Jan. 22–23
Altamont	Albany	Jan. 22–23
Cutchogue	Suffolk	Jan. 24
Rochester	Monroe	Jan. 24–25
Voorheesville	Albany	Jan. 24–25
Southampton	Suffolk	Jan. 25
Arcade	Wyoming	Jan. 25–26
Ithaca	Tompkins	Jan. 25–26
Northport	Suffolk	Jan. 26
Albion	Orleans	Jan. 26–27
East Greenbush	Rensselaer	Jan. 26–27
Warsaw	Wyoming	Jan. 26–27
Gansevoort	Saratoga	Jan. 29–30
Spring Valley	Rockland	Jan. 29–30
Springville	Erie	Jan. 29–30
Monticello	Sullivan	Jan. 31, Feb. 1
Franklinville	Cattaraugus	Jan. 31, Feb. 1
Greenfield Centre	Saratoga	Jan. 31, Feb. 1
Florida	Orange	Feb. 2–3
Olean	Cattaraugus	Feb. 2–3
Burnt Hills	Saratoga	Feb. 2–3
Glens Falls	Warren	Feb. 5–6
Angelica	Allegany	Feb. 5–6
Washingtonville	Orange	Feb. 5–6
Centreville	Allegany	Feb. 7

FARMERS' INSTITUTES — (*Continued*).

Place.	County.	Date.
New York	New York	Feb. 7–8
Fort Ann	Washington	Feb. 7–8
East Hartford	Washington	Feb. 8
Perry	Wyoming	Feb. 8–9
Cambridge	Washington	Feb. 9–10
Fishkill	Dutchess	Feb. 9–10
Canaseraga	Allegany	Feb. 10
Beachville	Steuben	Feb. 12
Hoosick Falls	Rensselaer	Feb. 12–13
Brewsters	Putnam	Feb. 12–13
Andover	Allegany	Feb. 13
Pattersonville	Schenectady	Feb. 14
Bedford Station	Westchester	Feb. 14
Rathbone	Steuben	Feb. 14–15
Amenia	Dutchess	Feb. 14–15
Hagaman	Montgomery	Feb. 15
Pine Plains	Dutchess	Feb. 16–17
Corning	Steuben	Feb. 16–17
Fultonville	Montgomery	Feb. 16–17
Savona	Steuben	Feb. 19
Rural Grove	Montgomery	Feb. 19
Rhinebeck	Dutchess	Feb. 19–20
Avoca	Steuben	Feb. 20
Johnstown	Fulton	Feb. 20–21
East Chatham	Columbia	Feb. 20–21
Livonia Station	Livingston	Feb. 21–22
Mayfield	Fulton	Feb. 22
West Henrietta	Monroe	Feb. 22–23
Clarksville	Albany	Feb. 23–24
Mumford	Monroe	Feb. 23–24
Norway	Herkimer	Feb. 23–24
Clifton Springs	Ontario	Feb. 26–27
Turin	Lewis	Feb. 26–27
Lowville	Lewis	Feb. 27–28
Copenhagen	Lewis	Feb. 28, March 1
Halls Corners	Ontario	Feb. 28, March 1
Camden	Oneida	March 1–2
Penn Yan	Yates	March 2–3
Fayetteville	Onondaga	March 2–3
Higginsville	Oneida	March 3
Tyrone	Schuyler	March 5
North Manlius	Onondaga	March 5–6
Watkins	Schuyler	March 6–7
Scipioville	Cayuga	March 7
Moravia	Cayuga	March 8
North Hector	Schuyler	March 8
Beaver Dams	Schuyler	March 8
East Venice	Cayuga	March 9
Wellsburg	Chemung	March 9–10
Groton	Tompkins	March 9–10
Ovid Centre	Seneca	March 12
Dryden	Tompkins	March 12–13
Big Flats	Chemung	March 12–13
Tioga Centre	Tioga	March 12–13
Berkshire	Tioga	March 13–14
Mechlenburg	Schuyler	March 13–14
Spencer	Tioga	March 14–15
Trumansburg	Tompkins	March 15–16

FARMERS' INSTITUTES — (*Continued*).

Place.	County.	Date.
Alpine	Schuyler	March 15–16
Marathon	Cortland	March 15–16
Syracuse Farmers' Club	Onondaga	March 17
Sinclairville	Chautauqua	March 17
Ransomville Farmers' Club	Niagara	April 18
Breakabeen	Schoharie	June 15
Beachville	Steuben	July 25
Jordan	Onondaga	Aug. 9
Elm Grove	Onondaga	Aug. 10
Thousand Island Park	Jefferson	Aug. 14
Charlton	Saratoga	Aug. 15
Wing's Station	Dutchess	Aug. 15
West Sand Lake	Rensselaer	Aug. 16
Warnerville	Schoharie	Aug. 16
Manlius	Onondaga	Aug. 16
Crumhorn Lake	Otsego	Aug. 17
Maryland	Otsego	Aug. 17
West Laurens	Otsego	Aug. 18
Schuyler Falls	Clinton	Aug. 23
Tulley Lake	Onondaga	Aug. 25
Gasport	Niagara	Aug. 25
Lakeside Park	Orleans	Aug. 27
Plessis	Jefferson	Aug. 29
Quaker Hill	Dutchess	Sept. 8
Pawling	Dutchess	Sept. 19
Denmark	Lewis	Sept. 29
Wilson	Niagara	Sept. 29
Jefferson	Schoharie	Oct. 10
Preston Hollow	Albany	Dec. 3–4
Marilla	Erie	Dec. 3–4
Madrid	St. Lawrence	Dec. 3–4
Winthrop	St. Lawrence	Dec. 5–6
East Aurora	Erie	Dec. 5–6
Durham	Greene	Dec. 5–6
Hensonville	Greene	Dec. 5–6
Briar Hill	St. Lawrence	Dec. 7
Cottage	Chautauqua	Dec. 7–8
Plessis	Jefferson	Dec. 8
Lexington	Greene	Dec. 8
La Fargeville	Jefferson	Dec. 10
Cherry Creek	Chautauqua	Dec. 10–11
Flieschmans	Delaware	Dec. 10–11
Dairymen's Assn., Watertown	Jefferson	Dec. 11–13
Clymer	Chautauqua	Dec. 12
Halcottsville	Delaware	Dec. 12–13
Panama	Chautauqua	Dec. 13–14
Pulaski	Oswego	Dec. 14–15
Nicholville	St. Lawrence	Dec. 14–15
Mayville	Chautauqua	Dec. 14–15
Grand Gorge	Delaware	Dec. 14–15
Stockton	Chautauqua	Dec. 17–18
Walton	Delaware	Dec. 17–18
Hammond	St. Lawrence	Dec. 17–18
Fayetteville	Onondaga	Dec. 17–18
State Breeders', Rochester	Monroe	Dec. 19–20
Gilbertsville	Otsego	Dec. 19–20
Ellington	Chautauqua	Dec. 19–20
Cortland	Cortland	Dec. 19–20

FARMERS' INSTITUTES — (*Continued*).

Place.	County.	Date.
Denmark	Lewis	Dec. 19–20
South Onondaga	Onondaga	Dec. 19–20
South New Berlin	Chenango	Dec. 21
Otto	Cattaraugus	Dec. 21–22
Turin	Lewis	Dec. 21–22
Cortland (Poultry)	Cortland	Dec. 21–22
New Berlin	Chenango	Dec. 22
North Manlius	Onondaga	Dec. 24
Russia	Herkimer	Dec. 26
Vernon	Oneida	Dec. 26–27
Trenton	Oneida	Dec. 26–27
Newport	Herkimer	Dec. 27
Clinton	Oneida	Dec. 28–29
Frankfort	Herkimer	Dec. 28–29
Constableville	Lewis	Dec. 28–29

Aside from the above regular farmers' institutes the following special bee-keepers' institutes were held during 1900:

Geneva	Ontario	Jan. 10
Batavia	Genesee	Dec. 12
Canandaigua	Ontario	Dec. 13–14
Romulus	Seneca	Dec. 15
Auburn	Cayuga	Dec. 17
Johnstown	Fulton	Dec. 18

Question Box.

ORCHARD AND SMALL FRUITS.

Fertilization and Care.

(Some answers by J. H. Hale of Connecticut.)

Question.— How shall we get color into apples?

Answer.— Potash and sunshine add color. Nature does the work when it has a chance. Too much nitrogen makes a pale color. As a rule, 200 pounds of potash is recommended per acre, but I use 300 to 400 pounds. Wood ashes have a value for their potash, phosphoric acid and lime.

Question.— Would it be advisable to sow oats among peach trees, the first year?

Answer.— No, sir.

Question.— Name four varieties of peaches for this locality (Orleans county) for a commercial orchard?

Answer.— Mountain Rose, Champion, Old Mixon and Stump for white; Crosby, Salway, St. John and Elberta for yellow.

Question.— Are tight boxes preferred for packing fruit?

Answer.— The tighter the package, the better, if the fruit is picked and packed when dry.

Question.— What kind of packages does Mr. Hale use for peaches?

Answer.— Our southern peaches are packed in Georgia carriers, holding four six-quart baskets. In Connecticut we use a half bushel package.

Question.— How often should peach trees be grubbed?

Answer.— So long as there are any grubs; as a rule, twice a year, in May and September. The best preventive against borers is banking the trees a foot high in May, with earth.

Question.— At what season is it best to prune peach trees, and would you cut them back each year?

Answer.— Cut them back each year early before the buds begin to swell. The best time is after the coldest winter weather is over.

Question.— How is the general fruit-grower to become posted on the markets of the world?

Answer.— By taking the leading horticultural papers or trade papers, and by joining horticultural societies and keeping in touch with the leading fruit-growers.

Question.— From which trees will we get fruit the quickest, young trees set out and left in grass or trees budded and grafted?

Answer.— I had 15,000 trees in Georgia six or eight years old from which I cut off the tops, cutting the heads back to six or eight buds. The next year I budded that new growth and the next year harvested a good crop of peaches. Put from six to fifteen buds in a tree. Always use buds from trees which we have seen in fruit, and do it in June, July, August or September.

Question.— Name varieties of apples that will fruit two barrels per tree at eight years of age?

Answer.— I could not do it because I don't live in New York; but we have done it in Connecticut on land said to be not worth $5 per acre.

Question.— How near the ground do you recommend heading the trees?

Answer.— From 15 to 18 inches. I aim to have my peaches so headed as to pick at least 75 per cent. of the fruit from the ground.

Question.— Name varieties of apples for an orchard of 1,000 trees for commercial purposes?

Answer.— I plant Rome Beauty, Southern Beauty and Baldwin as the main crop.

Question.— How may we know when we have the San José scale?

Answer.— You will know it when you have it, but I cannot describe it. The Lord has evidently sent it for the purpose of compelling us to take better care of the trees.

Question.— What kind of fertilizer should we use and at what time?

Answer.— Ask the land; would not want the same formula for all soils. As a rule, keep out stable manure. There is too much nitrogen in it, which produces a soft, unripened growth of wood and bud. Apply potash in the form of muriate or sulphate and add ground bone. I use from 1,200 to 1,500 pounds of the mixture per acre.

Question.— Which will keep best in cold storage, fruit fully ripe when picked or that picked somewhat green?

Answer.— Perfectly ripe. A mistake is made in picking fruit before it is ripe. I have kept well-ripened peaches a month in cold storage.

Question.— How do you assort your fruit?

Answer.— Hand work is the best; I hire girls to do it. They have better and keener perception, a better eye and are more honest than are men.

Question.— Would you head your trees low or high?

Answer.— I prefer low heads; but modern tools enable us to work closely to a tree whether it is headed high or low.

Question.— Should large limbs on trees be cut off?

Answer.— Not as a rule, but if they *must* be, do it in June and then paint over with white lead and oil.

Question.— What is the necessary pressure to have on a spray pump?

Answer.— Don't allow it to get below 80 pounds, if you would have a good spray.

Question.— I have an orchard that is in a very healthy, thrifty condition. It is 25 or 30 years old, but has never borne but two crops of apples. What is the matter?

Mr. Woodward.— There are many such cases recorded in this State. I believe the condition is due to the way the trees were propagated. Undoubtedly the roots were grafted with scions cut from barren trees. The nurserymen are to blame for it all. They ought to see to it that every root-graft is cut from strong, healthy, yearly-bearing trees. I should not, if I were to set an orchard next spring, buy a single tree of the varieties I wanted to plant. I would buy Northern Spy or Ben Davis. Two years later I would topwork them with the varieties I wanted, being very careful to cut the scions from trees that fruited yearly. Doubtless the original grafts in the orchard inquired about came from unfruitful trees. If the orchard were mine, I would topwork the same varieties, if I wanted them, on the trees, but would be sure the grafts came from bearing trees.

Question.— Does the stock in which a graft is set influence the fruit that grows on it?

Mr. Woodward.— Not a particle. All the influence comes through the leaf. The leaf also influences the root-growth of the tree. I can distinguish a Red Astrachan tree every time by looking at the root; and it is said there are nurserymen who can distinguish nearly every variety by its root-growth alone.

A Farmer.— I once set some grafts of "Camfield" in Red

Astrachan and Talman Sweet trees. The fruit on the grafts set in the Talman was hard and corky, while that on the Astrachan scions was as good as that grown on the original stocks. In these cases it seems that the tree *did* affect the quality of the fruit.

Question.— Which are the best white and red varieties of currants for all purposes?

Mr. Dawley.— It is a hard question to answer; there are a number of good varieties. For home use I know of none better than the old red Dutch; for market, Fay's Prolific or Cherry are good, but probably "President Wilder," a new red variety, is the best red sort. The best white variety is "White Imperial;" but white currants are not grown in a commercial way; only for home use.

Mr. Smith.— White Grape and White Dutch are good varieties, but not as good as White Imperial.

Question.— What is the advantage of a cover crop in the orchard, and what is best for such purpose?

Mr. Rice.— Some of the legumes, such as clover or peas, are good. We also sow an ounce and a half of flat turnip seed with twelve quarts of clover seed in our orchard, to turn under early the following spring; so as to supply not only more plant food but more humus to the soil. With a few week's growth in the fall, and one or two in the spring, it is surprising what good results will thus be obtained. They are almost as good as plowing under a good clover sod. I call the clover crop "the catch fertility crop," because, while detracting scarcely anything from the soil, it adds fertility and humus to it.

Question.— If you were to set an orchard the coming spring in Genesee or Wyoming counties, which of the following kinds of fruit would you select: pears, plums, prunes or apples? Describe the soil best adapted to each variety?

Mr. Smith.— If you have a fruit region here, and I assume you have, you know what soils are best. We are growing 3,000 varieties of fruits on the Geneva Station farm, the soil of which is a heavy clay, well under-drained. But these fruits grow on other soils just as well. As to which would be best to set, your markets will best decide. We can't come here and give you ironclad rules for growing fruit, nor can we make selections and advise you what sorts or varieties to plant. It is a local matter for you to decide.

Question.— What is the best way to keep borers from injuring young apple trees?

Mr. Woodward.— The best plan is to watch the trees, and, if borers are found in them, punch their heads off with a wire, by pushing it into the hole where the borers are.

Question.— Give the best method of treating apple trees after being broken down by ice? They are badly split.

Mr. Woodward.— I could tell much better if I could see the trees. If the body is broken, dig the tree out; if only the limbs, if not too close to the body, saw them off square and graft them, even if the same varieties have to be put in. But I should rather have an ice storm come along than to have some men in my orchard with a saw, trimming it.

Question.— When and how shall I trim peach trees that have received a great deal of attention and have made rapid growth?

A Farmer.— I should cut back last season's growth of leaders about two-thirds, and, if there were inside shoots that crossed and interfered, I should cut them out.

Question.— What catch crop is best to raise in a bearing apple orchard; for the especial benefit of the apple trees?

Mr. Rice.— Some of the legumes like the clovers. We sow crimson clover and turnips. The former, beside making a clover crop, adds nitrogen, which it takes from the atmosphere, and returns to the soil. Then, too, it will grow to late in the fall, and does not take moisture from the soil, needed by the trees. We also sow turnips in the clover. They make a good catch crop. We use them for feeding our hens later in the season. If crimson clover does not grow, try the red clover, sowing it in August or September first. It will make a sufficient growth before winter begins to cover the ground.

Question.— What would you do for an orchard of 500 trees, 30 years old, that had been affected?

Mr. Rice.— Affected with what? If it is the San José scale, the only remedy is to cut the trees out and burn them. Such trees are too large to treat successfully. We have such an old affected apple tree, standing near a plum orchard, which we shall cut out. Smaller trees we can spray with crude petroleum. It is a dirty job, but the most effective one I know. Nursery stock may be fumigated with hydrocyanic gas, which kills all animal life on it.

Question.— Is the so-called Middleburg plum exempt from black knot?

Mr. Mann.— Yes, sir; it is with me.

Question.— Does it not injure a young orchard to grow corn in it?

Mr. Rice.— Corn is a ravenous feeder, so should not be planted in a young orchard, but it is better than a sown crop, which does not admit of cultivation, while corn does. Then, corn not only shades the trees, but takes moisture from them. Beans or potatoes are crops more suited to a young orchard that is cultivated. We have a young orchard six or seven years old, that bore a number of apples on each tree almost, last season. The land has been cultivated.

Question.— Which is best, to mulch or cultivate an orchard; and if to mulch, how far from the trees and how deep should the mulch be?

Mr. Smith.— That is a question that cannot be decided in one way for every man. Good results from cultivation and mulch are seen. If, however, you have an orchard that has not been cultivated, go slow. Some of the best apples in cold storage at Buffalo for the Pan-American were grown in orchards that were mulched. But what is most needed is good thorough spraying, both to kill insects and to prevent scab. If you mulch, cover the ground six inches.

Question.— What causes plum trees to blossom every year, but fail to fruit?

Mr. Stevens.— As a rule there is too much nitrogen. Root-pruning will help somewhat. Drop off the nitrogen, and add phosphoric acid and potash. It is nature's first work to perfect seed, to do which it must have phosphoric acid.

Question.— Name the best three varieties of late pears to grow in this section (Steuben county), for profit?

Mr. Rice.— I don't know. With us, Beurre Bosc is one of the best. It has a long stem and hangs on when others go to the ground. Clairgeau is a good pear, and looks like Anjou, but is earlier in season.

A Farmer.— I would add Seckel.

Another Farmer.— Is not fruit-growing the proper work of the specialist?

Mr. Mann.— Yes; so is any farm work. I could never grow a crop of potatoes, corn, or anything else, except I got there early, attended to it, and did it thoroughly.

Question.— If one could get them for the expense of digging, would it pay to set out apple trees that are six inches in diameter, to fill in where trees have died out?

Mr. Witter.— Trees of that size are being set, which do well.

Question.— Give the best time to cut scions, and tell how to keep them till time to set them.

Mr. Woodward.— Cut the scions now (March 1). Place them in sawdust; or one may begin setting them now. I have set scions when the trees were in full bloom, and full leaf, but I do not like to do it, as they do not make as much growth as will earlier-set scions.

Question.— Do you think strawberries can be profitably grown on high clay ground, fertilized with green manure and fertilizers?

Mr. Woodward.— Almost any variety of strawberries will grow on any land except wet land. Select the variety that does best in your locality. On good soils, commercial fertilizers will be found better than barn manure, because there will be no weed seeds in them. Watch your neighbor's bed and select the varieties that are most successful with him.

Question.— How far apart each way should Cuthbert raspberries be set?

Mr. Chapman.— We set them in rows just far enough apart to go through with one-half of a spring tooth harrow, which is about six feet. The other way they are about two feet, which soon makes a hedge row.

Question.— Is red clover a good crop to grow in an apple orchard?

Mr. Abbey.— We are sowing red clover mixed with alfalfa, in our orchards, instead of crimson clover, which kills out. I know a young man in Wayne county, who is making a success in growing this mixture in his orchards. I have seen alfalfa roots, the first season, a foot long, or twice as long as the tops.

Mr. Smith.— I am surprised to know that alfalfa can be grown as a catch crop, in that way. I certainly did not know that it could. What was the soil?

Mr. Abbey.— The soil was a good, strong, gravelly loam, on high land, with no clay in it.

Question.— What will prevent black knot from getting on to cherry and plum trees?

Mr. Smith.— By cutting off all the knotty limbs and burning them. Don't throw them on the ground and leave them there; the spores will be blown about just the same, from these limbs as from knotty ones on the trees. But, you cannot grow plums and cherries if your neighbor's trees are knotty and left undisturbed. They will inoculate all the trees in the neighborhood.

Question.— Which poison is the best to kill the currant worm on the bushes?

Mr. Smith.— For most people, no doubt, white hellebore is best. It does not cost much. Where currants are grown on a large scale, some of the arsenical poisons, as a rule, are used, but the work must be done early and thoroughly. Don't wait, but apply the poison as soon as there is any sign of the worms.

A Farmer.— A man told me, recently, that he once bored holes in some of his fruit trees, filled them partly with sulphur, then plugged them up. Result: all the fruit on them was perfect, while that on the other trees was scabby and knotty. I should like to know if there is any foundation in the story?

Mr. Rice.— A fellow came along in our county (Westchester) one time, and met a physician, whom he told that he had a fluid, which, if injected into a tree, would make it healthy, and perfect its fruit. He would do it for $2 per tree. The doctor told him to go ahead, which he did. The doctor told me that he sometimes gives his patients hypodermic injections, and he thought such fluid injections might benefit the trees. I told him that the best way to inject life, and a good growth into a tree, and to insure a good crop of fruit, would be to inject nitrogen, potash and phosphoric acid into the soil, where the tree stands.

Mr. Smith.— I heard Prof. Beach say there was absolutely no foundation for the statement. If the plug is withdrawn, the sulphur will be found in the hole, but it might be possible that the boring of the holes checked wood-growth, and thus stimulated fruit-growth, but he very much doubted it.

Question.— Can pear trees five years of age be grafted in the stumps, the tops having been destroyed?

Mr. Woodward.— Perfectly easy. Cut them back till you get a good healthy stock and insert scions with three buds on each. Pear trees may be just as easily grafted as apple trees, and the grafts will live just as long.

Question.— I have an orchard which I wish to top-graft. Is it better to graft all at one time or be two or three years in finishing the job?

Mr. Woodward.— It would be far better to do it at one time, and one should put in lots of scions. The idea that it is better to be three or four years working a new top on a tree is an old-fogy one. But, when you select scions, cut them from annual-bearing trees and put the scions into small, not large limbs, unless you want to wait a number of years for fruit.

Question.— Should rye be sown in an orchard?

Mr. Rice.— It ought never to be sown in an orchard, except as a cover crop. It takes too much moisture from the trees. There are a few days when it may be used as a soiling crop, before oats and peas come on.

Question.— How should grafts be cared for the first and second year after they are set?

Mr. Smith.— Allow them all to grow the first year. The next year cut out one of them, allowing but one to grow on the cleft.

Question.— Are wood or coal ashes good for mulching currant bushes?

Mr. Smith.— There is quite a difference between coal ashes and wood ashes. The wood ashes contain potash and phosphoric acid, while the coal ashes contain neither, but coal ashes make a good mulch for currants as they keep the ground moist and prevent weeds growing.

Question.—Is it advisable to set Bubach and Parker Earle strawberries in the same bed?

Mr. Chapman.— It would do no harm. No harm would come from setting any two varieties in one bed. But we must be sure that one is pistillate and one staminate, so that blossoms will fertilize, else they will not fruit.

Question.— What about the Columbian raspberry?

Mr. Chapman.— It is a purple berry, similar to Shaffer's Colossal; of about the same quality, a very strong grower, and, where it succeeds, is well liked. But I think it would freeze out here (Lewis county). If I were living here I should set Cuthbert in preference to either Columbian or Shaffer.

Question.— Is it better to graft cherries into wild cherry trees, or buy the trees already grafted in the root at the nursery?

Mr. Woodward.— It will be much better to go to the nursery and buy trees budded on Mahaleo stock. The old red cherry that grows along the fences may be used as a stock, but it will be continually throwing up sprouts to bother you.

Question.— What season is the best to transplant young apple trees — spring or fall?

Mr. Woodward.— It will depend on the condition of the soil. If it is dry I should plant in the fall just as soon as the leaves have fallen. Such fall-planted trees make quite a root-growth before winter begins, and start earlier in the spring than will spring-planted trees. If, however, the soil is inclined to be wet in the fall and through the winter, I should plant them in the spring.

Question.— What causes black spots on some apples, and what will prevent them from appearing?

Mr. Smith.— The spots are caused by some sort of fungus. Thoroughly spraying with the Bordeaux mixture before the fungus appears, will prevent it. It prevents, not cures, the disease. Spray before the buds open, then again just after. Later add Paris green, then spray again after the blossoms have fallen. The Bordeaux prevents the scab, while the poison kills insects.

Question.— Will the sowing of rape in an orchard injure it?

Mr. Willard.— I will say I do not think so.

Question.— Would sawdust answer for covering strawberries when other litter is scarce?

Mr. Rice.— Some of you strawberry-growers answer.

Mr. Ames.— I prefer something a little coarser, like straw, if it is free from weed seeds. Some of our growers use hemlock brush. Almost anything, I think, would be preferable to sawdust.

Mr. Rice.— We prefer wheat straw to any other. It is not so coarse as is rye, and holds moisture better when used as a mulch. We go over the "patch" with forks and rakes before the plants come up, leaving just a little over the plants, so that their leaves will easily come through.

Question.— What causes plums to rot on the trees, and what is the remedy?

Mr. Smith.— Rot in plums is caused by a germ that produces the fungus. The remedy is to prevent it, by thoroughly spraying with the Bordeaux mixture, before the leaves appear; again before the blossoms open and again after the fruit has formed. But the work must be done early, promptly and thoroughly to prevent the rot. Pick off and destroy all rotten plums, and pick up those that have fallen from the trees, and burn them. Watch the fruit as it develops; and, as soon as you see the rot, pick off the diseased fruit; this to prevent spread of rot.

Question.— In pear orchards, would you mix Seckels with Bartletts, to secure better pollenization?

Mr. Willard.— I should prefer to mix Clapps with Bartletts. In an experiment on my place in covering pear trees in a way that kept the bees from them, they bore no fruit. This proved the necessity of pollenization.

Question.— When is the best time to prune grapes?

Mr. Chapman.— Any time during late fall or winter; do not wait until the sap starts or vines will bleed. Cut back to two buds. Prune apple trees any time before leaves start. Unproductive trees are sometimes made to bear more if pruned when leaves come out more.

Dr. Smead.— In pruning grapes, all depends on the kind of vine you have and the soil. Vines that are strong growers, and are growing in rich soil, should be allowed to make more wood than weak growers, or grapes in poor soil.

Question.— Do you recommend the spraying of orchards?

Mr. Mann.— I should spray the fruit trees; it is estimated that $3,000,000 is lost annually in New York State in fruit and other crops through the attack of insects and fungous diseases, nearly all of which might be prevented by judicious spraying. As a rule, the imperfect fruit is that which is blown off. It becomes weakened in the stem; the wood is also weakened by the attacks of insects and fungous diseases.

Mr. Litchard.— I once heard a man say he would spray his orchards even if he knew there would not be an apple on the trees. This to protect the foliage and perfect fruit buds for the next season.

Question.— Is it not possible to grow young apple trees too rapidly?

Mr. Rice.— Yes, it is quite possible to grow a tree so fast as to make the wood soft and unripe; besides, the trees grow out of shape. Ordinarily, however, young apple trees suffer more for want of manure than from an excess of it.

Question.— How many varieties of peaches do you grow commercially, Mr. Hale?

Answer.— Six.

Question.— When do you begin thinning the fruit?

Answer.— As soon as it is well set; when the peaches are about the size of cherries, or smaller.

By Mr. Farmer.— You said here (meeting of N. Y. Hort. Society at Rochester), two years ago, that you preferred Italian labor in the North. Which do you like best, now, Italian or the "Darky?"

Answer.— The "Nigger" in Georgia; Italian in the North.

Question.— What help do you employ to assort and pack peaches in Georgia?

Answer.— The brightest, smartest, prettiest girls I can get. They will assort and pack peaches as I order, and do the work rapidly and neatly — something I cannot get men to do. Then I hire an orchestra to furnish soul-inspiring music each afternoon.

By so doing I have been enabled to get 30 per cent. more work from my help than I formerly did.

Question.— What do you do to stop borers?

Answer.— Dig them out, beginning in October, early in the month. We go over the trees in October, then again in the spring.

Question.— How about the yellows. What do you do for those?

Answer.— Dig them out, and burn them "root and branch;" and it is best to begin before the disease appears. Don't wait.

Question.— How do you prune your peach trees?

Answer.— We cut out the central, strong-growing branches. Our object is to stimulate fruit production. The weaker limbs always bear fruit; the strong-growing ones the wood.

Question.— How close do you thin the fruit?

Answer.— We leave the peaches six inches apart; no less.

Question.— What is the best cover crop for an apple orchard, and when should it be sown?

Prof. Craig.— We must keep up the supply of humus in the orchard. A good catch of clover or other grasses cannot be secured without it, nor will fruit be perfected without it. All plants, as a rule, add to the fertility of the soil. The clovers are good because they are nitrogen catchers. Crimson clover, sown from the first to the middle of August, where it will thrive, makes a good cover crop, especially for peach orchards, because it grows late in the fall. Cow peas are also well adapted for such a crop. The red clovers grow on favorable soils in most localities.

The large hairy vetch is another nitrogenous plant and is quite closely allied to the clovers. All in all, I regard it better for such purpose than the clovers, because it covers the ground well during the season of apple-picking. It does not have to be rolled down, but falls down of itself; thus making a thick, soft carpet under the trees. If cow peas are sown, mix four or five pounds of Mammoth clover seed with them, per acre.

Question.— How much vetch seed should be sown per acre?

Prof. Craig.— A bushel and a half, drilled in. Harrow the ground finely, sow the seed, then roll the ground. The vetch is an annual, therefore it must be sown yearly. It is impossible to cut it except with a bean harvester or some machine of like character, because it lays so closely to the ground, but it is a good plant to plow under. I should not sow oats for a cover crop;

they draw too heavily on the moisture supply in the soil, which the trees ought to have.

The one objection to the hairy vetch is the scarcity of the seed, it not being commercially for sale in this country.

Mr. Hale.— How are we to obtain the seed, and what is the price? What is the outlook for it?

Prof. Craig.— The seed, so far, has been imported by the United States Department of Agriculture, from Europe. There is enough of it there, and, just as soon as there shall come a demand for it here, our seedsmen will have it on sale.

What about "chick weed?"

Prof. Craig.— I don't know. I think, however, that we can improve upon "chick weed" as a cover crop for an orchard.

Who grows the Atlantic strawberry?

Mr. Farmer.— I do. It is a very good variety.

What will dispose of the black borer in peach trees?

Prof. Slingerland.— It used to be said that this bug did not attack strong-growing trees, but I learn that it does. I know of no practical method by which "the chap" can either be kept in or out of the tree. I hope, however, that some "stopper" will soon be found.

Can fire blight in pears be prevented by spraying with any substance?

Several voices.— "No."

What is the best October peach?

Several fruit-growers.— "Elberta."

Mr. Hale.—We grow it in Georgia. It is a very good peach down there. It is a strong grower; has good foliage; is a great bearer and the fruit looks very attractive; but it is a cross between the Ben Davis apple and Kieffer pear, so far as quality is concerned, when grown in the North.

What will prevent canker or blight on the bodies of apple trees?

Prof. Stewart.— The blight is about identical with pear blight, and the same remedies are recommended for both.

Chick weed is choking out the crimson clover in our orchards. What shall we do?

Mr. Bogue.— If your orchards are in good condition and are fruiting well, you will have plenty of chick weed. I never make any effort to get rid of it. As a rule, it leaves the ground light and loose.

How shall we treat an orchard where large limbs must be cut off?

Mr. Hale.— Cut the limbs closely to the tree, then paint the wounds with white lead and linseed oil.

What remedy do you suggest for "bitter rot" in apples?

Prof. Beach.— It does not do much damage in New York, except on Long Island, but it appears in the South and in Missouri. When the conditions are favorable, the rot develops very rapidly. The Missouri Experiment Station has been making some experiments for the prevention of the disease, but I have not yet learned the results. I do not think it will develop enough in this State to warrant ever paying much attention to it.

What varieties of apples, and how far apart would you plant them in an orchard of ten acres?

Mr. Collimer.— Alexander, Duchesse and Twenty Ounce. Plant Alexander on the outside rows.

How does green arsenite compare with Paris green for spraying apple trees, both as to efficiency and expense? Is it readily soluble?

Mr. Woodward.— I have used green arsenite two years. It is more soluble in water than is Paris green, and so does not require so much agitating as does the green, while it does not cost so much.

Prof. Beach.— There is quite a difference between "green arsenite" and "green arsenoid," which every one concerned should bear in mind.

Mr. Mann.— I have had some experience with green arsenite. It has not been wholly satisfactory so far.

Mr. Woodward.— The arsenite of lime is just as good as is "green arsenite." It is much cheaper in price, and fully as soluble in water as is Paris green.

What is the cause of, and remedy for the dry rot, or "pink specks" on apples, extending through the fruit, mostly near the blossom end?

Prof. Beach.— As a rule, dry rot is met with but little in New York, except on Long Island. It is caused by a fungus, which produces a rot quite distinct from the "bitter rot." I do not know a remedy or preventive. Bitter rot may be checked or prevented by spraying with Bordeaux.

Why are apples larger and more highly colored when grown in sod than in cultivated orchards?

Mr. Hooker.— I think the reason is because, as a rule, the foliage is larger and more dense and the growth of wood larger where the trees are in cultivated land, thus excluding more of the sunlight, which, if the apples are to be well colored, they must have. I do not, however, advise the keeping of an orchard permanently in sod.

A Fruit-Grower.— In Orleans county, last year, the apples on trees in sod were not only of a higher color, but of a better quality than were those grown on trees on cultivated land.

Mr. Woodward.— The experience of last year has fully convinced me that the best place to grow an apple is in a pasture. Put sheep into the orchard, more than enough to eat all the grass. They will gobble up every wormy apple or wind-fall as soon as it drops. Then give the sheep enough grain to keep them thriving. Three cents' worth of bran per week, to a sheep, will do it. Apples so grown are not only of better color, but of better quality than are those grown on cultivated land. The finest "Rome Beauty" I ever saw was grown in pasture land last year, although the season was the driest I ever knew.

A Fruit-Grower.— Moisture is the most essential element needed for the apple, and I do not know how it can be conserved and stored up for an apple grown in sod in a pasture. Are there not varieties of winter apples not generally found in the orchards, that deserve more attention at the hands of orchardists?

A Fruit-Grower.— "Rome Beauty" is one of them.

Mr. Hooker.— Sutton and McClelland are good ones.

Mr. Woodward.—"Ontario" is the best new variety that I know. It is a cross between Northern Spy and Wagner; is about the size of a Medium Spy, and of very fine quality.

Is Wagner grown in western New York?

Two or three members said they grew it, but not successfully, except by thoroughly spraying. It is deficient and weak in root-growth.

What has been the experience of growers with Carman, Waddell, Willett and Triumph peaches?

Mr. Hale.— I know nothing of Willett. Triumph is the earliest variety we have of yellow peaches. But don't you grow it. Pull out and burn every tree you have; one tree will do, if you must have it, no more. Waddell is of the North China type and is a delicious white peach. Carman originated in Texas. It is one of the finest peaches grown; hardy in bud and otherwise, and will ripen in August here; but it rots very badly. So I would not plant it largely. St. John is the earliest variety I know. The best early free-stone peach I know, is Waddell; but I don't know much about cling-stone peaches.

From the outlook to-day, what is the most reliable and profitable fruit crop for the grower?

A Fruit-Grower.— The apple is the most reliable in my estimation, because the present generation is neglecting it. It is the surest money maker, the most reliable and the easiest grown of any of our fruits. With proper care, I believe the apple will come out ahead.

Mr. Hale.— There are more acres of apple orchard in Montana than in New York, and all have been planted within the last eight years; most of them within the last five. The same growth is true in Missouri, northern Michigan and elsewhere, and yet the growth of the apple orchards do not keep pace with the demand for the fruit here and abroad.

What is air-slaked lime worth for apple orchards, and how much would you apply per tree?

A Fruit-Grower.— I should not apply lime at all, unless the soil were acid.

What is the best remedy to kill cabbage worms?

Mr. Woodward.— Plant enough cabbage so that the worms will have enough to eat.

A Fruit-grower.— In Cortland county, N. Y., where many cabbage are grown, they don't pay any attention to the worm.

Will it pay to plant the Rome Beauty apple largely in western New York?

Mr. Woodward.— I never had a better bearer.

Others spoke highly of it.

Would you cut back pear trees to five buds after they were of three years' growth?

A Fruit-Grower.— If the trees were dwarfs I should cut them back that much every year; if they were standards, the growth and condition of the tree would determine it.

Is the peach profitable when budded on Myrobolam stock?

Mr. Hale.— I don't know; but I will say that I do not want a peach on any root but its own, for my planting.

What about the Japan chestnut?

Mr. Hale.— You will lose 50 to 60 per cent. of your plantings the first year; the next year you will lose 40 to 50 per cent. of what you had left, and, if the next season chances to be a dry one, you will lose 90 per cent. of the balance, so that you will only have a tree or two left.

How does Ben Davis compare with Baldwin in western New York?

A Fruit-Grower.— For the first eight years, Ben is ahead; subsequently, Baldwin wins.

Has any remedy or preventive been found for the cherry maggot?

Prof. Munson of Maine.— The maggot has appeared in Maine. We have sprayed, but without effect, because the flies lay their eggs under the skin of the cherry, so that the spray does not reach the maggot. I know of no real preventive.

Does the fumigating of nursery stock with hydrocyanic gas injure its quality?

Mr. King of Trumansburg.— I set 1,000 trees that had been fumigated with the gas, last year. Have not found that any of them are injured.

What will prevent curl-leaf on peaches?

A Fruit-Grower.— Spray the trees with the Bordeaux, before any buds open. It is the best preventive I know.

What shall we do with knotty raspberry bushes?

Prof. Munson.— Dig them out and burn all of them on the ground.

Which are the best plums?

Prof. Waugh of Vermont.— It is hard to decide. The Japs do not blossom alike in all sections; then there seems to be no standard commercial value of any one particular variety. Inquiries have brought out the fact that nearly every plum is differently judged according to the locality in which it is grown. Environment, climate and soils decide the question. This seems to be true of the Japs. Opinions and favorites change in different localities. There are men who think that the American varieties are good enough; others will plant none but the European sorts, while others still will have none but the Japs. So one must decide according to the whims and wishes of the fruit-growers of a locality, always being governed by hardiness of the tree and the demand of the local market. As a rule, nearly every variety has one or more objections. Some of them bear too much fruit; others, not enough. Some make too much wood; others not enough. Some have good foliage; others, do not, etc. For canning purposes, Burbank and Satsuma — both Japs — are most desirable. The variety known as "Wild Goose" is considered in some localities as best among the American varieties; while, in other plum-growing sections it is not grown at all.

What is the best early grape, all things considered?

A Fruit-Grower.— Green Mountain.

Mr. Mills.— Worden.

Is the Abundance plum self-fertilizing?

Prof. Waugh.— I do not think it is. Possibly, under some conditions, it is; but I find, after making many experiments, that it is not in all localities.

Shall we plant fruit trees in the spring or fall?

A Fruit-Grower.— Plant apples in the fall. Peaches and other stone fruits in the spring.

When is the best time to prune peach trees?

Mr. Hale.— At most any time; but I prefer to begin soon after February 1st, before the buds begin to open.

What is the best peach to plant?

Mr. Hale.— Ask the market. Grow that which is in most demand. For me, Champion, Old Mixon, Mountain Rose, Stump and Fox are the best five varieties — the first two ranking first.

Should lime be slaked rapidly or slowly for best results in spraying?

Prof. Beach.— Slowly. I pour on just enough water to slake the lime so that it will not burn, and leave a soft, creamy paste.

Is there any advantage from spraying while the trees are in bloom?

Prof. Beach.— That is an open question; but the bee-keepers have procured the passage of a law preventing the spraying of trees while in bloom. An effort was made to repeal the law, the result being an amendment allowing the State Experiment Station men to spray while the trees are in bloom. They have sprayed four orchards in different counties in the State. In some orchards, the scab fungus nearly destroyed the blossoms. When the trees were sprayed during the bloom season, much of the fungus was held in check. As a rule, the yield of fruit is not much diminished. I have found a loss of a fraction of a bushel to a bushel and a half of apples per tree. In the Geneva Station orchard the trees were sprayed several times during the blossoming season, the object being to hit every blossom. Some trees were sprayed on one side only. The side unsprayed produced but little fruit; while on the other side the fruit nearly broke down the tree. There is no danger, however, in spraying while the trees are in bloom, instances having been brought to light where the bees carried the poison on their wings, to the hives and thus poisoned the whole colony. If a man has a large orchard, however, he cannot always manage to spray it all when he would like. An orchardist has told me that he has lost considerable money through spraying trees when in bloom. As a rule, I prefer to spray just as soon as the last blossoms fall.

The only object in spraying the trees when in bloom is to prevent the appearance of the scab fungus.

Mr. Mills.— If you want to destroy our best friend — the honey bee — spray the trees when in blossom. I know an instance where a large number of colonies were thus destroyed. If you will continue the practice of spraying your trees while in bloom, I will guarantee that you will not have a honey bee in your neighborhood five years from now.

To Mr. Hale.— How many acres of peaches are you growing?

Answer.— I have 2,100 acres of bearing peach trees in Georgia and about 200 acres in Connecticut. I planted the first commercial peach orchard in Connecticut 30 years ago. It contained 100 acres. Since that time more than 2,500,000 peach trees have been planted in that State. My first peach orchards in Georgia were planted 11 years ago.

ABOUT SPRAYS AND SPRAYING INSECTS AND INSECTICIDES — SOME INSTRUCTIONS.

Question.— Can beans and peas be sprayed in any way to keep bugs out of them?

Mr. Smith.— Not for the weavil; but you want to treat the beans and peas after they have been thrashed. Get a 25-cent bottle of Carbon bi-Sulphide, put a little in a saucer, set it in the mouth of the bags or bins and cover tightly. It throws off a heavy gas which settles all through the beans or peas and kills all animal life in them. But one must be careful in handling it, as it is not only poisonous but very explosive; so do not go near it with fire.

Question.— How can you prevent apples becoming wormy?

Mr. Chapman.— Spraying with Paris green, a few days after the blossoms fall, will, as a rule, kill the worms.

Question.— What poison shall we use to kill the canker worm?

Mr. Smith.— White arsenic, or Paris green. The arsenic is mixed with soda and is fully effective as is Paris green, will remain in suspension better and costs less. Very many of the orchardists in the vicinity of Geneva used it in place of Paris green, last year. If you are going to spray to kill the canker worm, do it just as the foliage begins to come out.

Question.— What remedy do you suggest for lice on currant leaves?

Mr. Smith.— Whale oil soap is the best remedy I know. It should be sprayed on as soon as the lice appear.

Question.— When plums rot one year will they necessarily do it the next? What causes it, and what is the preventive?

Mr. Stevens.— As a rule, plum rot is caused by some air germ; but there may be some soil germ. Spraying with the Bordeaux mixture, when done before the buds open, tends to prevent the air germ from working.

Question.— What will kill lice on black raspberry bushes?

Mr. Smith.— An emulsion of whale oil soap is as good as anything I know. One pound of soap dissolved in four gallons of water, sprayed on. Do it when the first signs of the lice appear.

Question.— Is arsenate of lime as effectual as are insecticides or Paris green?

Mr. Woodward.— Green arsenoid or arsenic of lime or of soda are preferable to Paris green. White arsenic and common washing soda is much better than the green. Mix one pound of white arsenic with two pounds of washing soda in one gallon of water and boil it 15 minutes, which will make a perfect mixture, and one which will remain in suspension much longer than will Paris green.

Question.— What will kill smut on seed oats, and how much to use?

Mr. Smith.— Hot water at a temperature of 132°. Below that degree the smut germ will not be affected, but it is killed at that figure. If the water is at a higher degree the live germ of the grain will be killed.

Question.— Will not corrosive sublimate kill the smut?

Mr. Smith.— No; it is not used for that purpose, but is for destroying the potato scab. After the oats have been soaked 10 minutes in the hot water, spread them out to dry.

Question.— What is the best remedy to kill lice on cattle?

Mr. Smith.— Anything that will stop their breathing; grease will do it, so will road dust. Whatever you do, do it often, as the eggs hatch rapidly, so that to get rid of the lice, one must apply the remedy quite often for a while. Keep up the treatment until all are destroyed. Tobacco water will also kill them.

A Farmer.— Give the animals all the grain they want. If you do that, there will not be many lice.

Mr. Smith.— Once the vermin get into the stable, grain will not drive them out. I have seen lice on very fleshy cattle.

Dr. Smead.— Kerosene and lard in the winter, equal parts, melted. Put it on with a brush. The louse lives on the sweat of the animal. The calf does not sweat, neither does the poor animal. So it is best to use some remedy to kill the louse quickly. The old remedy was a mercurial one. The louse is a biter, not a sucker, so it must be poisoned. Washing by some of the sheep dips will kill it.

Mr. Chapman said that kerosene and water, one-fourth kerosene and three-fourths water, put on with a horse brush, would kill them.

Question.— We are afraid of the San José scale. What are your suggestions regarding it?

Mr. Smith.— Mr. Woodward says that if he finds any of the scale on his trees he piles corn stalks around them and burns them up. But it is claimed that fairly good results are obtained from spraying the tree with crude petroleum of about 40 per cent. strength. Nursery stock is being fumigated with the hydrocyanic gas, also some small fruit trees, by using a tent over them, but it cannot be used on large trees, nor can all the scales be reached on such trees by spraying. As the scale multiplies rapidly, if any are not reached by the spray, but little progress is reached toward exterminating the scale.

A Farmer.— I have the scale; sprayed my orchard with crude oil, and nearly killed some of the trees. I consider the remedy fully as bad as the disease.

Mr. Woodward.— A solution made of resin soap is fully as good as the oil, and not at all dangerous.

A Farmer.— Does the scale work on any tree except that of fruit?

Mr. Woodward.— Yes. It works on some forest trees, lilac bushes, currants, and other shrubs and fruits; also on fruit.

Mr. Smith.— If I owned an orchard and suspected the presence of the scale, I should have an expert from the State Department of Agriculture to visit it and begin the campaign at once. One could not afford to wait.

Question.— Can you describe the San José scale, so that one can detect it at sight?

Mr. Smith.— No one can describe it or even detect it except an expert. To prove the statement Mr. Smith showed a photograph of a San José mother scale with a number of young scales near it, which, he said had been magnified several hundred diameters — some five or six hundred — and yet were very small. It is very difficult to detect the scale when on wood, but it is more easily seen on the fruit. Spraying of the trees with 40 per cent. petroleum, on small trees will destroy the scale, but it is very hard to reach them all on large trees. Unless all are hit, the increase will go on, as one scale will multiply many hundred times in a season and the work of reproduction begins very early in the season. I should not buy a tree from a nursery that had not been treated with the hydrocyanic gas.

Question.— How long will it take the San José scale to destroy an ordinary orchard, after it has been introduced?

Mr. Witter.— No doubt it would depend on the condition of the orchard. It would only be a question of a few years.

Question.— A resin wash was recommended at Hornellsville to spray to kill the San José scale. What is the formula for preparing it, and how much should be used?

Mr. Woodward.— There are several formulas for making it. We use the resin washes for the bark louse and plum scale, but have not used it for San José scale, because we do not have it; but I am confident it will be found as good for that scale. It is being used in California, and it is said seals up the young scale so that it cannot get from under it. One of the best formulas is: 2 pounds of common resin, 1 pound of caustic soda, 1 pint of fish oil, and 2 gallons of water. Mix and boil; when cool it will look like thick, yellow soft soap. Dilute in 40 gallons of water.

Question.— How about whale oil soap mixed with kerosene oil?

Mr. Rice.— I don't know; we have never used it. We are treating our plum orchard with the gas, using a large tent which covers the trees, and we expect to eradicate the scale on these trees, but it will be many years before we can drive it out of the apple orchards, as the trees are too large to treat by using the tent and gas. We spray our very young trees with crude petroleum, before the leaves come out, to kill the scale. It has 25 per cent. strength.

Question.— Which is the best to spray with, green arsenoid or white arsenic and soda? Which costs most?

Mr. Smith.— White arsenic and washing soda, one pound of white arsenic, 4 pounds of soda and 2 gallons of water. A pound of arsenic used in that way is equal to two pounds of Paris green, so that twice the quantity of water will be required than would with Paris green.

Mr. Woodward.— Dissolve the arsenic and soda by boiling them 15 minutes. The cost is much less than is Paris green, and the mixture is much easier sprayed on, as it remains much longer in suspension, than does the green.

Question.— How many times would you spray fruit trees?

Prof. Low.— Spray four times, at intervals of about 10 days, using poison to kill insects, and the Bordeaux mixture mixed, the last time, to prevent the leaf blight and the scab fungus from appearing.

Mr. Rice.— The time to spray is early in the season. Do it the first time before the leaf buds open. Put in the arsenic with the Bordeaux mixture for this spraying. The Bordeaux will ward off the fungus, and the poison will kill the insects, especially the early hatched tent caterpillars. The next spraying is made just after the blossoms have fallen, when the little apples are in an upright position, and their calix standing up. The last spraying is done when the little apples are of the size of hickory nuts.

To Mr. Mann.— How many times do you spray?

Answer.— I spray first, just before the buds open, then again soon after the blossoms fall, repeating the operation every four or five sprayings, using the Bordeaux mixture. I also use a pound of Paris green in 54 gallons of the Bordeaux, for every spraying, even the one before the buds open. I have never burned any foliage with that formula, except on peach trees. I know it is not the standard formula, but I have found it the best. I used it to kill the forest worm, and killed the whole mass with one spraying.

Question.— When shall we spray to kill the codling moth?

Mr. Smith.— Just after the blossoms have fallen and the calix end of the young apple is standing upward. The poison falls into the calix or blossom end, and, when the worm begins to eat its way into the apple, it is killed by the poison. Paris green, green arsenoid and white arsenic are used. White arsenic is mixed with common washing soda, and remains in suspension much better than does Paris green, and costs much less, while it is fully as effective.

Question.— Is there a law to prevent spraying fruit trees while in blossom?

Mr. Rice read the text of such a law, and said it was enacted at the solicitation of the bee-keepers, it having been proved that the spraying of trees while in bloom, not only poisoned the bees who were in the blossom in search of honey, but that they had actually carried the poison on their wings, to the hive, thereby poisoning the whole colony. He would not, in any case, spray trees with poison during the blossoming period, because it neither prevents the attacks of the fungus nor kills the insects, while it has been proved that it very seriously injures the fruit.

Question.— What is the cause of beans not coming in leaf after coming up? What is the remedy?

Mr. Woodward.— It is what is known as "anthracnose," a little canker spot that comes out on the stalk and eats off the bean leaf before it has an opportunity to grow. The remedy is spraying with the Bordeaux mixture, early, as soon as the beans begin to appear.

SILOS, ENSILAGE AND CORN.

Question.— What shall I feed with ensilage and wheat straw to my cows, to balance the ration?

Mr. Smith.— Wheat bran and oil meal. The straw and the ensilage are both carbonaceous in their nature. To balance them, there is nothing better than the wheat bran and oil meal.

Question.— At what age would you commence to feed ensilage to a young heifer that is to be raised for a dairy cow, if she is fed bran and clover or mixed hay?

Mr. Walter.— We feed our calves, as soon as they will eat any roughage, a little ensilage.

Mr. Smith.—A little succulent food is good for the calf, but for the first year it should have something that will promote growth. Clover hay, wheat bran and roots make the best ration.

Question.— What is the value of a ton of ensilage, compared with hay?

Mr. Van Wagenen.— Cornell has done some valuable work in that line, having fed considerable of it. Their verdict is one-half the value of hay.

Question.— What is Kaffir corn?

Mr. Smith.— It is a variety best suited for arid regions, and produces its corn on the top of the stalk, as does broom corn.

Question.— Will ensilage, if fed to cows, loosen their teeth?

Mr. Gould.— I have two cows which have eaten ensilage 14 years, but their teeth are all right.

Mr. Smith.— I have seen many old cows that had been fed ensilage a number of years; none of them had been injured in any way by it. Of course, ensilage may be so grown and put into the silo as to become very acid. Such ensilage would, no doubt, injure a cow. But, when it is well grown, properly put up and properly fed, no ill results will rise from feeding it. There is no truth in the report. All this talk about corn ensilage loosening cows' teeth and otherwise injuring them, is simply rot. Of course, one may overfeed just before milking, and thus taint the milk. The same would occur if one overfed his cows with clover. When corn is properly grown, put into good tight silo and properly fed, it will make as good cattle food as will any other crop ever grown.

Question.— What variety of corn does Mr. Gould use for his ensilage?

Answer.— I get a white flint field corn, grown on the Blue Ridge in Virginia. It is a rank grower and will produce 15 tons per acre; but it does not mature in every locality sufficiently for seed.

Question.— How about ensilage for working horses?

Mr. Smith.— Ensilage fed to working horses, in not too large quantities, is all right. Prof. Roberts bought a horse 13 years old, and used him to peddle milk all winter. He had all the ensilage he would eat, and came out fat in the spring. But, there are men who fail in feeding ensilage to any animal, because they either do not have good ensilage or else they feed it improperly, *i. e.:* feed too much. There are many sheep breeders who feed ensilage to both sheep and lambs, and succeed, while others fail. It is so with cows or horses. Good judgment must be used in either case.

Question.— Does corn ensilage injure the quality of milk? If not, why do some condensaries reject it?

Mr. Smith.— The Bordens reject milk from ensilage-fed cows. It is because some farmers persist in overfeeding with ensilage made from immature corn. But there are condensaries which do not. On the other hand, they are bidding for it. In hundreds of creameries and cheese factories, milk is received from herds fed ensilage, and no objections are made.

Mr. Lillie.— I never spoiled any milk by feeding ensilage, but I have heard of its being spoiled by improperly feeding it. But, good ensilage made from matured corn, will not injure milk, but it should be fed after milking, for the purpose of avoiding the absorbing of any odors.

Mr. Smith.— Good ensilage — that from mature corn — properly cured, if it is properly balanced with nitrogenous grains and not too much of it fed, will produce better milk than any other cattle food I know. That is the universal verdict of those who are feeding it.

Question.— If ensilage is such a fine food, why can it not be fed alone?

Mr. Smith.— I will again say that it should not be fed alone, because it is a one-sided food, its elements being sugar and starch. The cow should have protein foods to balance it. A man would not care to live on pie or some other one food, alone; so, too, the cow does not want to be confined to ensilage. If she is expected to make milk, she must have something beside starch and sugar.

Question.— What is the best ensilage crop aside from corn?

Mr. Litchard.— I know of no crop as good as corn. We want ensilage for its starch and sugar. More of these elements can be produced from an acre of corn than in any other crop. Let the ensilage be balanced with the protein foods, such as wheat bran, clover, gluten, etc.

Mr. Cook.— We have no right to compare corn with pea vines or clover as ensilage crops; one is carbonaceous, the others nitrogenous.

Dr. Smead.— Some farmers want sorghum for the silo, but why shall we grow it? We are after carbohydrates in ensilage; that being our object, why grow sorghum, when we can get them in corn at less cost? Clover, pea vines and other crops have been put in the silo; but I find it best to use the corn for ensilage, and then balance it with the clover and other protein foods.

Question.— What variety of corn does Mr. Van Alstyne prefer for the silo?

Answer.— We have gone to extremes in growing ensilage. At first we planted too much seed. The next time we did not plant enough seed. My preference is a happy medium in ensilage. I grow the variety that produces most and matures earliest in my neighborhood. So far, I prefer "Leaming," having tried all the others. I plant 12 quarts of seed per acre, and, as a rule, harvest about 15 tons of ensilage. We aim to cut our ensilage when the ears begin to dent, and to put it into the silo as rapidly as possible.

Question.— Is "Pride of the North" corn a balanced ration for dairy cows, after being cured in the shock?

Mr. Smith.— I suppose that has reference to cutting the stalks as we talked about this morning and which Mr. Lillie answered. Prof. Voorhees of New Jersey, experimented on the lines of dry corn fodder and ensilage for three years. Everything was analyzed. The result was a loss of but five per cent. in ensilage, while that in corn, cured as soon as possible after cutting, was 24 per cent.; in that left three or four weeks, there was an additional loss of nearly 15 per cent. Then, too, there was a gain of 15 per cent. in milk for the ensilage corn over that from the stalks. A cow weighing 1,000 pounds requires a pound of protein per day to keep her in normal condition. If she is giving 20 pounds of milk per day she will require about two and one-quarter pounds of it. This she could not obtain from corn, unless she was forced to eat more than she could store and digest.

So, then, neither "Pride of the North" nor any other variety of corn, whether "cured in the shock" or put into the silo, would be a balanced ration for a dairy cow.

Question.— What do you think about picking off some of the ears on heavy ensilage corn?

Mr. Lillie.— It has been proved time and again that it does not pay to pick some of the ears from ensilage corn. It is much better to cut it all into the silo. If it is very rich in corn, feed a smaller quantity of the ensilage. It costs too much to go through a field of ensilage corn, pick off a part of the ears and husk them.

Mr. Smith.— Add a little gluten feed to balance such ensilage. It will help, wonderfully. I should not pick off the surplus ears from the corn.

Question.— Will ears of corn lose any food value by being put into the silo?

Mr. Smith.— Yes; but not as much as iis lost when the ears are allowed to ripen and then husked. Corn's greatest value is when the kernel is in the dough stage. Experiments at Cornell showed there was $14 value in an acre of corn when in tassel stage; when it reached the silk stage there was a value of $28; but, when in the dough stage, $42. There is quite a per cent. in favor of the silo, as between ensilage corn and dry corn stalks, and well-preserved, properly-grown ensilage.

Question.— Does the freezing of ensilage injure it?

Dr. Smead.— No. If ensilage freezes a few inches on the outer edge, rake it into the center of the silo and allow it to thaw out. If you will insert a thermometer a foot into the ensilage in the center of a silo, you will find the temperature from 50° to 70°, so that the frozen ensilage will quickly thaw out. But little, if any loss will result from the small quantity frozen.

Question.— At what season should corn be cut for ensilage?

Mr. Rice.— Experiments made with corn cut when it was in the tassel, silk and dough stage, showed three times as much value in the last cutting than the first one contained. This increased value was in sugar and starch, all made after the tassels appeared. There was not much of any increase in the volume of the stalks, after the tassel stage, so that when the corn is in the dough stage, which is just before it glazes, more feeding value will be got from it than when cut before or at a later time. But, remember, corn is a sun plant and will not grow in its own shade, nor in that of a tree or building. Plant it thinly enough so that at least one good ear will develop on a stalk.

Question.— Is not pea-vine ensilage of more value than corn, and is not the manure from it of more value than from corn ensilage?

A Farmer.— I have fed both pea-vine and corn ensilage, and have found that I got fully as much milk from corn as from the pea ensilage.

Mr. Cook.— It is not so much owing to the individuality of a food as to what it contains. If you are looking for the starchy food, the corn is worth the most; if for protein, the peas.

Question.— What is the temperature of ensilage below the surface?

A Farmer.— I tried mine with a thermometer this morning and found a temperature of 72° a foot below the surface.

Mr. Cook.— I don't know; have never made any records; but I am going to furnish each of my three men with a good thermometer for the purpose of ascertaining the degrees of temperature of not only the ensilage, but also stables.

Question.— Does ensilage give milk a bad smell or taste?

Mr. Gould.— No; if it does, why do some condensaries bid for ensilage milk.

Mr. Smith.— The condensary at Frankfort encourages the feeding of ensilage; so does the one at St. Johnsville; only the Borden people reject milk made from ensilage. When a farmer will make good ensilage, feed it properly and balance it with protein foods, there will be no milk refused anywhere. It there is, the man who refuses it will get none at all.

Question.— Shall we feed ensilage before or after milking?

Mr. Smith.— After milking, always. As a rule, any fermented food will taint milk through the breath of the cow. When fed after milkings, if the cows are milked but twice a day, the milk is not affected. A Mr. Tracy of Tioga county, who milked his cows three times a day, found his noon milking slightly affected, but not the night milk. We have been feeding our cows at the Geneva Station ensilage both winter and summer, and making butter, but have never detected anything detrimental in feeding it.

Mr. Gould.— It is better first to ascertain whether milk has been tainted by ensilage or something else.

Question.— Is it preferable to drill in corn instead of planting it in check rows for ensilage?

Mr. Gould.— I think the drill system is preferable to the check row, as more stalks can be grown on an acre, while the corn may be kept fully as clean as in the check rows.

Question.— Is ensilage alone a good food for a milch cow?

Mr. Goodrich.—No. It does not contain protein enough. Some good clover hay should be fed with it. You may keep a cow a year on ensilage or other starch foods, but, at the end of the year, she will not be any better, nor as good as she was when you began feeding her, because she has had to take protein from her body to maintain life, thus causing her to become thin in flesh.

Mr. Rice.— It is a wasteful process to undertake to keep a cow on corn fodder alone, or with corn meal mixed with it. The cow cannot eat and digest enough of such foods, therefore, when an excess is fed, a portion of them is lost. It is much more profitable, and much better for the cow, to balance such foods with some of the protein foods, such as clover, bran, gluten, oil meal or cotton seed meal; but I should not feed a cow more than two pounds of cotton seed meal per day. You can afford to pay $20 per ton for gluten feed to mix with your corn. If you can get 45 cents per bushel, sell a portion of the corn and invest in gluten feed at $20, and I should add some wheat bran. Of course, all depends on the quality of your coarse fodder.

Question.— Who has had experience with corn ensilage as a summer food for cows?

A Farmer.— I had a little that was left over from spring. When I began feeding it in summer I found a little spoiled on top; the rest was as perfect as when it went into the silo.

Mr. Smith.— We have fed ensilage in summer to our cows at the Geneva Station; we had some left over which we covered with straw until we wanted it. That was two years ago; last year we did practically the same. Our cows got the ensilage, the young stock the alfalfa. I think it is only a question of time when the dairymen will abandon soiling crops and substitute the summer silo for them.

Question.— Which is the best ensilage cutter?

Mr. Smith.— There are a large number of them, and all are good. So it would be a hard matter to say which one was better than another.

A Farmer.— Why not use a shredder?

Mr. Woodward.— I would not give a continental for the difference in cutters if they only do the work. We cut our ensilage half an inch in length, and I believe that ensilage cut at that length is fully as good as shredded ensilage.

Mr. Dawley.— Our ensilage has been shredded during the last four years. I am very sure I can get one-fifth more shredded than ordinary cut ensilage into a silo. But if the ensilage is cut as short as Mr. Woodward cuts his, I see no advantage in the shredder over the cutter. But whichever you use get power enough. We use a 12-horse engine when shredding ensilage.

Question.— Will the cow get any more nutrition from cut or shredded cornstalks than from whole stalks?

Mr. Cook.— I should cut or shred cornstalks, for the purpose of making them more palatable, not to make them of more feeding value, because the cutting or shredding of them will not add to their feeding value.

Question.— What is the best length to cut ensilage?

Answer.— Two or three farmers voted for half-inch lengths, but one farmer favored an inch.

Question.— In what proportion shall we compare corn ensilage with good stock hay?

Dr. Smead.— What does stock hay mean?

Mr. Cook.— About one-third clover and two-thirds timothy will be the average.

Mr. Litchard.— Three tons of ensilage to one of good hay.

Dr. Smead.— Ensilage is a food that cannot be sold by the barrel or sack, so that it is quite difficult to determine its market value.

Mr. Snell.— My cows have done better on early cut clover and timothy hay than on ensilage, but the ensilage was of sweet corn with the ears picked off. I have two silos which I have filled two or three years, and have yet to find any benefit from the ensilage over the hay.

Mr. Cook.— We cannot compare corn ensilage with clover hay. The two are as wide apart as are the poles. Clover is a protein, ensilage a starch food, but both are needed to balance a ration. There is no crop from which we can get so much sugar and starch as from good, well-matured ensilage.

Question.— Should ensilage corn that is quite green be allowed to wilt for a day or so after cutting, before putting it into the silo?

Mr. Cook.— Yes, if very green; but should not be allowed to get too dry. Last year our corn was a little too dry. This season, by following the reaper pretty close with the wagon, we had moisture enough. But it is a very close thing to determine just how much moisture the corn should have. If it becomes too dry it should be wet when it goes over the carrier and into the silo.

Dr. Smead.— In the early days of ensilage, much loss was experienced from putting the corn into the silo in an immature stage.

It soured and made a vinegary ensilage that injured both the cows and their milk. Experiments in Ohio went to prove that, for best ensilage, the corn should be cut about five days earlier than when it is to be husked.

Question.— At what length should corn be cut for ensilage, one-half or one-fourth inch?

Mr. Van Wagenen.— If the corn is cut to one-fourth inch lengths, it will pack more closely in the silo, and I incline to the belief that the cows will eat the ensilage more closely than they will if cut longer.

Question.— Which contains the most food value, the ear or the cornstalk? At what stage is its greatest food value?

Mr. Smith.— There is most food value in the stalk. When a stalk of corn has been well grown and has one good ear on it, if it be cut when the corn begins to glaze, it will contain its greatest food value. The stalk is then worth more than is the ear, and nearly 70 per cent. of that value is in that part of the stalk below that ear. Therefore, if the ear is allowed fully to ripen, then the stalk is cut, stooked and the ear is husked and the loss in feeding value of the stalk is from 24 to 40 per cent. There is also a small loss in corn when it is allowed fully to ripen and become hard. If you feed a cow a well-balanced ration, seven-eighths will be dry matter, and 70 per cent. digestible. The unit value of a stalk and ear of corn, at the dent or glazing stage, is 45 for the ear, as against 55 for the stalk.

Question.— Do ripe ears of corn lose much of their feeding value when put in the silo?

Dr. Smead.— Corn ensilage, when fermentation has not gone too far, is so far advanced in the stage of digestion. It requires about three times as much energy to digest dry corn stalks or corn as it does to digest ensilage.

Question.— I had surplus corn enough, after filling my silo, to last till January 15; would it be better to have fed out of the silo until that time and then refilled it from this overplus corn?

Dr. Smead.— If, by the question, it is meant to keep that corn till after the first ensilage is fed, my opinion is that it would not have had much value. It would have dried out too much.

A Farmer.— I filled my silo about the first of November, and, when it was half fed out, cut in the corn and stalks left over. I wet them down, however. Results not as good as from the first ensilage, but better than from the dry corn stalks.

Some other farmers related a like experience.

Question.— Has a farmer, who feeds his cows ensilage, any right to draw his milk to a cheese factory or milk station in this State?

Mr. Smith.— Yes, sir; there is nothing in any law on the statute books to prevent it. The best butter made here and in the West is made largely from ensilage, during the winter.

Question.— Is milk made from ensilage acceptable in the New York market?

Mr. Smith.— Milk made from ensilage is acceptable anywhere, except at some of the condensaries. There is no better milk produced than that from ensilage. Nearly all the fancy butter made in the West is of milk from ensilage-fed cows. The only trouble has been with farmers who overfed their cows with ensilage that was green and immature, and which soon turned sour. But a cow may be fed 40 pounds of good ensilage a day, in two feeds, without injury to her milk.

Question.— Is mold in ensilage caused by the corn being too ripe when cut?

Mr. Rice.— Very frequently it is the cause. When, however, corn is cut before it becomes too ripe, put into a tight silo and well packed, it will not mold. If the air gets in, the ensilage will not only mold, but rot. Cut it when it is in the dough stage, and put it directly into a good, tight silo.

Question.— Can whole ensilage be kept as perfectly in the silo as can that which has been cut?

Mr. Gould.— I do not believe it can, although I have seen it that was all right. It was very closely packed. But it requires too much labor to get it out of the silo.

To Mr. Litchard.— What is the best way to grow corn for ensilage?

Answer.— We manure a clover sod during the winter. Plow it early, roll down, fit well and plant Pride of the North or Leaming, both dent varieties, give good cultivation, and, just as the earliest ears are glazing or denting, cut the whole mass and put it into the silo.

Question.— How does it affect ensilage to wet it before it goes into the silo? Will it spoil if the silo leaks?

Mr. Lillie.— Sometimes, when the corn is overripe or has become too dry, we wet it before cutting it into the silo. This is to prevent the ensilage from molding. Wetting, causes it to heat, thus preventing its molding. If there is no crevice where air can get in, I do not think there ought to be any loss from leaking.

Question.— Would it pay to build a silo if one had but five cows?

Mr. Dawley.— If a man has five *good* cows, he can afford to build a silo. Have it round and deep. About two inches per day, fed from a silo, will keep the ensilage from spoiling.

Question.— What does it cost to grow ensilage and put it into the silo?

Mr. Woodward.— From $1 to $1.75 per ton, depending on the quantity of the crop.

Question.— What is the best cover for the ensilage after the silo has been filled?

Mr. VanAlstyne.— The best cover we have found so far is sawdust.

Question.— Which is the better, the round or square form of silo; what is the cost per ton capacity?

Mr. Dawley.— As a rule, I think the stave silo is preferable to the square one. They may be built more cheaply and will last just as long, but they must be well built. Round or flat iron hoops, or cable-iron hoops are used. If one is going to build a silo, he should not, for the purpose of saving a few dollars, build a cheap one. As a choice between the two, pine or hemlock, I believe I should choose the latter. It costs about as much as does pine, but I believe it will last longer than will any other of our native woods. The cost will vary from $1 to $2 per ton capacity.

Dr. Smead.— The cheapest silo is a round stave one, and requires less space. I prefer staves two inches by six, and I should not build one outside the barn, unless the staves were matched. It will require about 1,800 feet of lumber for a silo with a capacity of 50 tons. Georgia, white or yellow pines make a good silo, so does hemlock, which is somewhat cheaper than are the pines. Either round or flat iron make good hoops.

Mr. Benjamin.— I built a silo and used fence wire. Am convinced that it is better than the iron hoops, as it shrinks and expands with the silo more easily than do the round iron hoops.

Question.— Is blue clay a good article for the bottom of a silo?

Mr. Litchard.— No, sir; it is not. Put in cement. I once put in a clay floor in a silo; when I had fed out the ensilage I found half a dozen rat-holes. I at once pulled out the clay and put in cement.

Question.— Which is most durable, a round or square silo?

A Farmer.— I have a round one that I have used six years and it is all right; have never spent a dollar on it in repairs. The hoops are round iron drawn up by lugs; have tightened them up but once; there is no trouble in keeping ensilage in it; the staves are matched.

Mr. Smith.— The silo at the Geneva Station is a square one, and has been there eight or nine years. It keeps ensilage well; I do not think there have been many repairs made. But, if I were going to build a wooden silo of any form, I should treat the wood with some of the various wood preservatives.

Mr. Woodward.— The best silo I ever saw was in Ontario. It was made of staves, lined with brick and then cemented. It was frost and air proof. If I were going to build a costly silo, I should certainly line it with bricks and cover them with cement. Such a silo will last a lifetime, although more costly than one without bricks and cement. As a rule, the cheap stave silo shrinks and swells, bursts its hoops or blows over. It does not pay to build a cheap silo.

Question.— Which are preferable for silos, stone and cement or wood?

Mr. Lillie.— They are all good, but the stone and cement silo will cost the most, except under very favorable conditions. The silo ought to be 25 to 30 feet deep, but the cost of getting the stone and cement up to that height is too great. I should build a wooden one. Mr. Gurler of Illinois is building silos which are lathed and cemented on the inside. They are said to be very durable and otherwise satisfactory.

Question.— Is it the best way for me to build my silo in my barn?

Mr. Gould.— If I were going to build one of my own, and but one, I should build it in the barn. I built mine in the barn because I could afford the room, and because I could store seven times more food in it than I otherwise could. But ensilage gives off moisture, which is unfavorable in a barn.

Question.— Is there any harm in feeding frozen ensilage to cattle; if so, what?

Mr. Gould.— No; but there is no need of feeding frozen ensilage. If it has frozen on the outside, rake it into the center, and allow it to thaw out before feeding.

Question.— Will the feeding of ensilage cause abortion in cows?

Mr. Gould.— No.

Question.— Is there sufficient plant food in the average soil to grow a good crop of corn for the silo?

Mr. Dardis.— I have raised two big crops of corn in succession on an old night pasture.

Mr. Smith.— There is enough nitrogen, potash and phosphoric acid in average soils to grow large crops for a long period of years, but the trouble is, these elements of plant food are locked up so that the plants cannot reach them. There is a lack both of moisture and humus. Both must be present to dissolve and hold these plant foods. As a rule, there is plant food enough in our average soils to supply the needs of our crops, if it can be utilized properly.

Question.— What do you think of rye, cut for ensilage for summer feeding?

Mr. Smith.— I do not think much of rye. It is all right to feed when green, about two days; after that time the straw becomes hard, woody and hollow. Those who have fed it say: "Don't do it."

Question.— What is the best crop for soiling in the summer?

Mr. Smith.— The most value is in good corn ensilage. Build a silo this summer for use next summer, and put in enough corn to fill it. When the milk flow shows signs of falling off, open the silo and begin feeding the contents. You will find it better than any soiling crop you can grow, and it costs less.

Question.— To what animals may ensilage be fed? Is it good for horses or growing cattle? How old must a calf be before it will eat it? Will it keep through the winter and into the dry season next summer? Do you use anything but corn to make it? What does it cost per acre to harvest the corn and put it into the silo? What distance should it be planted? What varieties are best?

Mr. Woodward.— A calf will eat it as soon as it will eat any other coarse food. We plant it three feet apart one way. Ensilage is a good food for any animal, except I should not feed much of it to a horse. Feed four pounds of ensilage to 100 pounds of sheep. Ensilage will keep indefinitely when it is put into a good, tight silo. It is just as good in June as in January, and is the cheapest food that can be grown on the farm.

Question.— What variety of corn is best to plant — I want the ripe grain to crib and the stalks to feed dry?

Mr. Smith.— Evidently the man who wrote this question does not believe in the silo and so prefers to follow the old way of disposing of his corn crop. My idea is that he should experiment and find out for himself. We cannot tell him what variety of corn or other crops to grow, because we do not know his conditions. It is one of the questions we cannot answer.

Question.— What kind of corn is best for ensilage in this locality, Delaware county?

Richmond Garrison.— We have always thought until last year the Early Mastodon was best for us, but last season, by the advice of John Gould, given at the institute here a year ago, we tried what is known as Turner's White ensilage corn, and find that a better variety, judging by one season's trial.

Question.— Does ripe corn lose in feeding value by being put in the silo?

Mr. Cook.— If the silo is made tight, I believe there will not be a loss of more than five per cent. Under unfavorable conditions, there may be a loss as high as 25 per cent.

Question.-- Will ensilage spoil milk for condensing?

Mr. Cook.— Good ensilage, as a partial ration, when properly fed, will make good condensed milk. I cannot understand why the condensaries do not take milk from cows that are fed ensilage, only for the fact that some will feed poor ensilage, and feed it either immediately before, or at the time the milking is being done. I should feed ensilage, if I had to dispose of my milk in some other way.

Mr. Barlow.— Whenever I have made ensilage milk into butter for market, or shipped my milk to New York, my customers have wanted more, which I take to be good evidence that the ensilage does not injure the quality.

Question.— What causes blue mold in a good, tight, well-built silo?

Mr. Woodward.— The cause is too ripe or dry corn when it was put into the silo. There was not enough dampness in the ensilage. If ensilage becomes sour, it was cut when too green; if it rots, it is because the air gets into the silo.

Question.— Which is better for corn, old ground plowed in the fall or sod plowed just before planting?

Mr. Gould.— It is a question of locality. If ground is frozen all winter, fall plowing is all right. We always plow in spring, as our winters are so open. We plow our sod at least 20 days before planting, that decomposition may begin. Work the land thoroughly to kill all weeds.

QUESTIONS REGARDING ANIMAL FOOD.

Question.— What benefit is derived from feeding buckwheat hulls?

Mr. Van Alstyne.— I have never been able to get any benefit. They are good as a fertilizer, because of the potash in them. Buckwheat middlings are a good milk-producing food. There is but little protein in buckwheat hulls, and what little there is comes from the middlings that stick to them in small quantities.

Question.— Which should farmers depend on mostly, soiling or pasture?

Mr. Litchard.— About three seasons out of four are dry, and we are going to keep our cows in the stable, feeding them some soiling crops, such as ensilage or oats and peas. We keep the cows in the stable during the day and turn them out at night.

Mr. Cook.— The question of labor and the condition of the land must be considered. Much of the land in northern New York cannot be cultivated and must be pastured. If I were to start in again I should not buy an inch of ground that I could not cultivate. We are practicing soiling in connection with the pasture, but I am quite satisfied that the tendency is drifting from the pasture toward soiling. One thing is sure, if our land is worth $100 per acre we cannot afford to allow our cows to roam over it; and a man owning such land ought to keep at least one cow per acre, and will, when he has the summer silo.

Question.— I am feeding ensilage twice a day and timothy hay once; what grain ration shall I feed?

Mr. Bentley.— Wheat bran and gluten.

Mr. Smith.— I believe that bran and gluten will make as good a ration as any, and it is certainly as cheap in price as any. There are elements in bran not found in gluten to any great extent, which is its mineral matter, making it valuable. When we feed these grains we do it for their protein element, to mix with our fat-forming foods, and so should first consider price.

Question.— Would bran with 10 pounds of Rockford gluten be a safe grain for a cow fed ensilage twice a day and straw once?

Mr. Smith.— Corn is deficient in mineral element; gluten is made from corn, and is therefore deficient in mineral matter, so I should mix it with bran. Of course there are conditions that enter in, we cannot lay down any special rules. There is a difference in glutens, but, as a rule, they are guaranteed to contain 27 per cent. protein. We find they hold up well in analysis.

Question.— I am feeding in equal parts, corn meal middlings with good ensilage, morning and night. Can I get better results by adding gluten instead of the meal?

Mr. Cook.— The chances are that if you feed a cow constantly on that ration in time you will have no cow.

Question.— Can we increase the butter fat in a cow's milk?

Mr. Cook.— Sometimes. It would depend on the cow's normal capacity. She has one, but one may force her below it. If the cow has been kept up to that condition, the fat cannot be permanently increased. I tried my best permanently to increase the butter fat in a herd of eight cows, but could not do it. One of the hardest things to understand is the feeding value of a food. We must bear in mind that there is no difference between the protein in the gluten, bran or cotton seed meal, but there is a difference in its per cent. in these foods, so we must be governed by that factor, and at the same time take into consideration the palatability of a food. For instance, there is a greater per cent. of protein in cotton seed meal than in bran, and, at present prices, the cheaper to buy, but it is not nearly so palatable as the bran.

A Farmer.— A mixture of cotton seed and wheat bran or gluten, half and half sprinkled on the ensilage or other coarse foods, has given me better results than has any other combination I have tried, and I am surprised that the farmers do not feed more cotton seed than they do.

Question.— Which is the cheaper and best to buy for making milk, wheat bran or corn meal?

Mr. Smith.— The two foods are not comparable. One is a starchy, the other a protein food. Both are necessary in the make up of a cow's ration; the corn to produce the needed heat and fat, the bran to produce the muscle and blood.

Question.— What is the difference, if any, between winter and spring wheat bran for feeding purposes?

Mr. Smith.— Not very much. Experiments to quite a large extent were made in Pennsylvania a year or two ago; as I remember it, the results did not show much, if any, difference. If you can get good, coarse, flaky bran, do not worry over the difference in price.

A Farmer.—'I think that you will find in the Pennsylvania report a small difference in favor of spring wheat bran.

Mr. Smith.— The law does not require an analysis of wheat bran, but any mixed feed should bear on its tags its analysis; and I should not buy a pound of any mixed feed except I had an analysis of it. Every cattle food dealer in the State has been served with a copy of the law; but, if you do not compel the manufacturer to live up to it, you will get no benefit therefrom.

Question.— What would be the proper ground ration for dairy cows, not giving milk, which will freshen in March, the coarse foods being oat straw, pea straw, timothy hay, cut green, and corn fodder cured in the shock?

Mr. Lillie.— Without figuring the ration, I should put in corn meal and wheat bran for Michigan. I figure that there is no food so cheap as good corn for furnishing carbohydrates. So, if one feeds corn stalks, he should add some corn. When the cows are dry, they do not require so much protein. That would be furnished by the wheat bran. There would also be some in the other foods.

Mr. Smith.— The question of palatability in food ought to be considered in selecting or combining foods; but it is not quite as necessary with dry as with milch cows.

Question.— Which is the better for a cow, corn or barley?

Mr. Smith.— There is not much difference in their analyses. Both are starchy foods, but there will be more value gotten out of the corn than the barley, because so much more may be grown on an acre.

Question.— Can gluten food be safely fed when dry, if mixed with wheat bran or corn meal?

Mr. Rice.— Certainly; much of it is being used. It is a very dry feed and rich in protein. Fed with good corn ensilage it makes a nicely balanced ration. It is much richer in protein than is wheat bran. But there are two forms of gluten, one is meal, the other gluten feed. The former is much the richer in protein, and the price should be higher for it; but both are often sold by dealers as gluten meal.

Question.— How does it compare with corn meal?

Mr. Rice.— It does not compare, there being more than three times as much protein in it. Corn meal contains about seven per cent., wheat bran 11, and gluten meal 25 per cent.

Question.— Is rape a good fodder for cattle, when cured like hay?

Mr. Rice.— I should not think that rape was a good food for cattle, but it is wonderfully good for sheep.

Dr. Curryer.— We grow it in the West, sowing it in the corn at its last cultivation. It makes an excellent food for sheep; also for cattle, except milch cows.

Question.— Has any one in this (Steuben) county raised cow peas, either for plowing under or for fodder? If so, with what results?

A Farmer.— I have sown them in a limited way and will sow more.

Mr. Rice.— They are, properly, a bean, and are of most value to plow under for nitrogen. In the South they are cured for hay, and are also put in the silo. They are full of protein, and, when they can be utilized as hay, they will be found valuable. A gentleman at Lyndonville told me that he had cut and cured them for hay. It is a little more difficult to cure them than clover, but they are richer in protein. If you are going to plow them under, do it before the frost comes. "Whippoorwill," an early variety, is the best with us. The seed costs from $1 to $1.25 per bushel.

Question.— Since corn meal is practically figured out of all animal rations, what shall we do with it?

Mr. Rice.— Corn meal is one of the best of foods, but it must be balanced with protein; so must ensilage or corn stalks. I suppose some persons are of opinion that institute speakers do not favor corn meal. It is not true; but we have favored corn ensilage in preference to corn meal and corn stalks, because there is more food value in it; besides, there is a succulent value in ensilage which cannot be obtained in either corn meal or corn stalks. We must always study the nutritive value of foods, then so mix them as properly to balance the ration.

Question.— Would it do to cut rye for hay when it is in the blossom stage?

Dr. Curryer.— There is no question that it will make good hay if cut before it becomes hard and woody, and this is before the blossoming stage.

Question.— What kind of grain should be fed with swale hay to have cattle do well?

Mr. Van Wagenen.— I doubt not that if the cow is given 20 pounds of good swale hay and 10 pounds of protein foods she will give a good flow of milk, if she is of the dairy type.

Question.— Should we have corn ground — cob and all?

Mr. Cook.— There is but little feeding value in the cob, but it aids digestion. It should be ground finely. I think that our ordinary steel mills do not grind it fine enough. If taken to a mill the cost is too much. I have no use for a miller to grind corn. I can utilize it better and more cheaply through the silo.

Question.— Can you get as much milk from common corn stalks as from sweet corn stalks?

Mr. Cook.— Yes, I do; and can back up what I say by proof. It is cheaper to grow the common corn, and there is more feeding value in it.

Question.— Is it advisable, if you have plenty of oats and corn, to mix bran or wheat middlings with them at $18 per ton?

Mr. Smith.— Corn meal is a starchy food, so is timothy hay or corn stalks. When you feed either of those foods together you simply increase the sugar and starch and feed more than the animal can digest. If those foods are balanced, protein foods must be given. Oats, wheat bran, gluten and other like foods should be given in connection with the carbonaceous foods. I should sell some of the corn and buy oats or some other of the protein foods.

Question.— How much protein should a cow be fed per day?

Dr. Smead.— A cow weighing 1,000 pounds, in milk, ought to have two and one-half pounds per day, and about 13 or 14 pounds of carbohydrates. If she is dry, about one-half that quantity.

Question.— Of what value are malt sprouts as a food for milch cows?

Mr. Smith.— If you can buy them at $10 per ton, it is the cheapest form in which you can buy protein. They contain about 25 per cent. of this element.

Question.— What is the best and cheapest feed for cows where the average price of milk would not exceed two cents a quart?

Mr. Smith.— You cannot make it at that price unless you have a good cow. Then you must feed her plenty of good, digestible food. Milk can be made more cheaply from ensilage than any other feed. You can get more value in dry matter to the acre in alfalfa than in any other crop. It is a protein feed and will help balance your ensilage. A grain ration of wheat bran, cotton seed meal or dried brewers' grains, with the ensilage and alfalfa or clover hay will make milk as cheaply as it is possible to make it.

To Mr. Gould.— Is the cow pea a good crop to grow?

Mr. Gould.— Yes; but it is a hot weather crop and will not stand frost. Drill it in with every other tooth of the drill taken out. In that way it may be cultivated, which will hasten the ripening period. It is valuable because it is wonderfully rich in nitrogen.

A Farmer.— I tried them last year. The season was not long enough for them.

Question.— Does it pay to raise oats for feed when they can be bought for 32 cents per bushel?

Mr. Smith.— No man can say what another man should do. It is one of those things every man must decide for himself. Probably, if you can trade them for bran, it will pay.

Mr. Woodward.— That would be $20 per ton for the oats. So it would be better to trade the oats for wheat bran, as that may be bought for $14 per ton.

Question.— Is rape a good food for cows?

Mr. Smith.— It will do for dry cows, but I should not feed much of it to milch cows, as it taints the milk. But for sheep, when fed properly, it is an excellent and cheaply grown food.

Question.— My cows are fed bean fodder once a day and corn stalks twice, with three quarts — by measure — of corn meal and bran, morning and night. What is lacking in the ration?

Mr. Goodrich.— That ration is deficient in protein, because the cow cannot get the quantity she needs — at least two pounds per day — from it. I should put in some oil meal, gluten or cotton seed meal, in place of the corn. I should estimate a ton of well-cured and preserved bean fodder as nearly equal to one of clover, although I have not the analysis with me. The chemist knows much, but we must submit his report to the old cow. I think much of the chemist, but fully as much of the cow. She is the umpire. Remember, the cow must have a variety of foods, and they must be palatable to produce best results.

Question.— How does barley meal compare as a ration for milch cows, with other feeds?

Dr. Smead.— There must be palatability in a food to make it digestible. If it is distasteful, it will not digest so well. Barley has a nutritive ratio of 1 to 8; oats, 1 to 6; timothy, 1 to 14 or 15; clover, 1 to 5 or 6. The proper ratio should be 1 to 4, 5 or 6, according to the individuality of the animal, something which the farmer must study for himself. Barley is not as good a ration as oats, but wheat bran and barley, half and half, will make a fairly good balanced ration. If I had good hay, a silo and wheat bran, I should not feed barley at all.

Question.— Shall we feed meal dry or wet?

Dr. Smead.— Dry. Digestion begins in the mouth. The cow will wet it enough through her saliva, of which she secretes about five gallons every 24 hours. All experiments I know have decided that grain fed dry is best assimilated and digested by the animals.

Question.— What is the cheapest fattening ration for two and three-year-old cattle?

Mr. Smith.— The only thing for an eastern man to do is to follow the plan of the western man. He uses the silo. There is no better plan. Clover hay, corn ensilage, wheat bran, corn meal are the foods. If the ensilage is rich in corn, not so much corn meal will be required; and it is better to add some wheat bran. It serves to keep the animal more healthy than does so much corn, while it fattens just as rapidly.

Question.— How about ground peas for cows?

Mr. Smith.— They are excellent, having nearly 20 per cent. of protein; they are also very digestible.

Question.—What is the feeding value of hominy meal?

Mr. Smith.— Compared with wheat bran at $15 per ton, it is worth $8.52. If you want something in place of corn meal, "hominy chop" is all right. It is a carbonaceous food, just as is corn meal, so it should not be fed with the corn, to balance the ration.

Question.— Will it pay to grow carrots and mangels for cows when one has ensilage, to produce milk?

Mr. Smith.— No; if you have ensilage, do not raise roots; but, if you do not have the ensilage, by all means raise roots — mangels will be the best.

Question.— Is beet pulp a reliable cattle food? Will it spoil if kept? What can we afford to pay for it?

Mr. Smith.— There is about 8 to 10 per cent. of solids in beet pulp. When it is fresh and sweet, it is good; but it is simply a question as to its feeding value. Professor Wing of Cornell, says it has a feeding value of about one-half that of corn ensilage. Compared with ensilage at a cost of $2 per ton, outside figures, it is worth $1 per ton. One had better grow mangels, because, in those he will get all the solids, while from the sugar-beet pulp all the sugar has been taken out. The balance is water, woody fiber and about eight-tenths of 1 per cent. of protein. I doubt if any one can afford to pay $3 per ton for it. If course, pulp has some value in its succulence, and is a good food if it can be bought cheaply enough. If properly cared for, it will keep some time.

Mr. Woodward.— I can grow ensilage and put it into my silos for $1.25 per ton, but I should not give half that for sugar-beet pulp. They cannot sell it to me; would much prefer the waste molasses from the beet-sugar factory. But, if I wanted some succulent feed, I should grow mangels; they contain some sugar, while the beet pulp has none, and when fed judiciously, in connection with other foods, are an excellent succulent food. If we will begin with a few, and increase moderately, a large quantity of mangels may be fed. I have fed as high as a half-bushel, twice a day, to a cow. But, remember, if mangels or ensilage is fed, the animals must be kept indoors. It will not do to allow them to run out in cold weather.

A Farmer.— I fed mangels to three cows, but was obliged to discontinue their use, as they were too loosening.

Mr. Woodward.— I have never had any trouble in that way when I fed enough coarse food with them.

A Farmer.— I am feeding corn meal and shorts with my ensilage. I am feeding it that way to get better digestion.

Question.— Will it pay to cut hay for the live-stock, then sprinkle the meal and shorts on the hay or ensilage?

Dr. Smead.— If the ensilage is very heavily eared, it would be better to sell the surplus corn, and buy bran. As to the cutting of hay, I should say that it does not add nutrition to cut it; but there is an advantage in cutting and steaming hay, if it is overripe, and then mixing the grain ration with it. If one has early cut, well-cured hay, I doubt if it will pay to do it, especially when the animal is in a good, healthy condition.

Mr. Cook.— If I were at home and had charge of the herd, I should, no doubt, mix the grain with the ensilage. But I do not believe it makes a cent's worth of difference with the cow. All experiments I have made or consulted go to prove that it does not pay to cut the hay. With the horse it may pay. I experimented with five cows, cut the hay, fed the grain before and after the coarse food, watered before and after, and watched results. I found that whenever I made a change, the cows invariably shrank in milk. I am convinced that the best way is to follow a uniform system of feeding — doing everything on time and doing it regularly. Uniformity is what does the business more than anything else.

Question.— Are apples a suitable food for milch cows?

Mr. Smith.— They may be, if fed judiciously. Do not feed more than four quarts at a time, twice a day.

Question.— Is timothy hay "fit" to feed a cow giving milk?

Mr. Smith.— Not if you want to make a profit on her milk. She cannot digest enough of it to keep up her milk flow.

Question.— What is the value of gluten, compared with corn meal and other foods?

Mr. Smith.— Gluten meal contains four times as much protein as does corn meal, although it is a product of corn. But, in preparing it all the starch of the corn has been taken out. But, do not figure gluten feed and gluten meal alike. There is about 10 per cent. more value in the meal than in the feed, which is in its protein. Corn meal produces fat, and balances the protein when properly combined with it. Wheat bran is probably the best and most profitable to use as a protein food for young and growing animals, because it builds up the bone structure and furnishes blood and muscle. Prices govern as between it and other protein foods.

Question.— Which contains the most feeding value, oats or beets?

Mr. Smith.— Beets contain more than 98 per cent. of water. Their value consists in their succulence. We like an apple because of its flavor and water. Oats contain but little water, so that there is but very little comparison between the two. Experiments at Cornell University in feeding beet pulp to steers showed that when such pulp was in good condition (if the farmer had nothing else of a succulent nature) it was worth about half as much as corn ensilage. If he had other like foods, the pulp was worth very little. If ensilage was worth, therefore, $2 per ton, the pulp would be worth $1, provided the farmer did not have any ensilage. I understand that some farmers have paid as much as $3.50 per ton for the pulp delivered, which is fully $2.50 too much.

Question.— What is your opinion of oats for spring pasture?

Mr. Smith.— Who of you has tried oats for pasture?

A Farmer.— I have, but don't like them.

Mr. Smith.— Some farmers sow rye in the fall, which is pastured off in the spring, then plowed under. Good results are reported. I don't know about oats for like purpose.

Mr. Lillie.— Prof. Shaw of Minnesota, has experimented with oats for such a purpose. He reported good results.

A Farmer.— How would it answer to grind beans and oats and mix the two?

Mr. Smith.— I do not know why such a mixture would not make a good protein food.

Dr. Smead.— We must first take into consideration the palatability of a food. Peas are much better than beans because they contain more protein and are more palatable. There is something in the bean that makes it distasteful to the cow.

A Farmer.— Cook the beans and mix them with bran. The cows will eat them all right in that way.

Another Farmer.— I am feeding beans to horses. They eat them well and seem to do nicely.

The question brought out a variety of opinions, some radically different.

Question.— Can sorghum be raised successfully in this country, and is it a profitable crop for feed?

Mr. Creenon.— I have raised sorghum; that which I sowed, did well; that which was planted, did not. We sowed two bushels of seed to the acre, and got more food from an acre than from corn. It was cut just as it began to turn a yellow color, and cured as hay. The cattle ate it all and gave a nice mess of milk. The stalks were about the size of a lead pencil.

Question.— Are turnips a comparatively valuable crop for live-stock, considering cost?

Mr. Litchard.— I think they are for sheep. The Canadians are far ahead of us in that direction. But, if a man can raise good corn, and can have ensilage, he will not need turnips or beets.

Question.— What is the difference in feeding value of corn and wheat bran?

Mr. Woodward.— The two do not compare. Corn is a fattening food, bran a growing one. One is fed to produce heat and fat, the other to produce muscle, bone and blood. To get best results corn and bran should be combined. Corn, when fed to an excess, will fatten the cow and dry up her milk; bran will help to keep up the milk flow. Corn is principally starch, while bran contains but three parts of it to one of protein.

Question.— What do you consider a good ration for cows in milk?

Mr. Smith.— Corn ensilage, wheat bran, clover hay, linseed meal or gluten meal, ground oats, cotton seed meal, and alfalfa, are good foods for the purpose.

Question.— When is the best time to feed grain to cows, before or after feeding hay?

Mr. Woodward.— We feed our cows the first thing in the morning; then the cows are milked, and the ensilage fed, the grain having been sprinkled on the ensilage. Straw is fed at noon; hay again before milking, and the ensilage and grain afterwards, at night.

Question.— How much water does a cow need daily?

Mr. Smith.— It will depend on the cow, her foods and other circumstances. A cow will drink from 75 to 125 pounds of water daily, if she has a chance to take it when she wants it; but, if she is turned out in zero weather, she will not drink half the quantity she needs or requires.

Question.— Please explain the feeding value of gluten meal fed for dairy food and milk produce and protein?

Mr. Smith said that gluten meal contained about 34 per cent. of protein, gluten feed, 27 per cent. and corn bran, 10 per cent.; but the latter costs too much for the price. When you buy any of these prepared foods, insist on a guaranteed analysis, and do not pay too much for them.

Question.— Can sorghum be raised for fodder in this locality — Steuben county?

Mr. Woodward.—It may be, but it will never pay a man to grow it who can grow corn. Not so much may be grown on an acre. I tried it once and found it did not do me any good.

Question.— How is bran, corn meal and ground oats, if mixed in equal parts, for cows?

Mr. Woodward.—It would depend on the coarse fodder the cattle are getting. If ensilage or timothy hay or straw is fed, no corn meal should be fed. If clover is fed, and the ensilage is not rich enough in corn, feed some corn meal. The other foods named are all right.

Question.— Give a ration for dry cows.

Mr. Smith.— A cow weighing 1,000 pounds, not giving milk, requires a ration containing one pound of protein per day to keep up her normal condition. If she gives milk, more protein should be added, because the cow must have protein to produce milk, and it must be a quantity in excess of her daily needs. Two-thirds of the food is needed to repair waste tissues. The other third to supply additional requirements. The ratio should be about one part of digestible protein to five of carbohydrates, those foods which are fattening.

Question.— Will millet take the place of good hay for milch cows?

Dr. Smead.— Millet, when cut at the proper time, which is just as it is heading out, has a ratio of about 1 to 10, while timothy has 1 to 14; so that is better than timothy. But the millet must be cut before it goes to seed, else it will become hard and woody.

Question.— Which variety is best, the German or Hungarian millet?

Dr. Smead.— Practically, there is but little difference; the German is the earliest, Hungarian the finest. Both analyze about the same.

Question.— What is the ration for a dairy cow?

Mr. Smith.— It will depend on the coarse foods.

A Farmer.— I am feeding corn ensilage, oats and hay. I do not think, however, that I am feeding protein enough.

Mr. Smith.— Oats are not a narrow ration, and they do not contain as much protein as do some other foods. It is better to mix some pea meal with them or wheat bran.

Question.— Would 10 pounds of good timothy hay be enough for a cow?

Mr. Smith.— There is a difference in timothy hay, but what you or I might call "good" would not be so considered by the New York dealer. When it is cut before the seed begins to perfect, it is better for the milch cow, but the New York buyer prefers to have it more fully ripened. If the hay is too much ripened, a cow would have to eat about 70 pounds of it to obtain a sufficient supply of protein, a quantity she cannot eat and digest.

Question.— Which would be most profitable, to pasture cows in summer, or feed them corn ensilage?

Mr. Lillie.—I think there is no doubt that it would be far better to feed the ensilage in place of pasture, and I believe the time is rapidly coming when we will abandon the pasture, especially where the land is high in price. Pasturage costs too much when compared with ensilage. Only on land which is not tillable can we afford now to pasture. But every dairyman ought to have a summer silo, no matter how much pasture he has, because he cannot depend on pasture when the drouths come, but he can depend on the silo when filled with good ensilage.

Question.— Give a ration for cows that give over 50 pounds of milk per day — with ensilage, timothy hay, pea and oat hay and oats unthreshed.

Mr. Lillie.— Fifty pounds of ensilage, five pounds of timothy hay, 10 pounds of pea and oat hay, and 16 pounds of oats. It would give 2.54 pounds of protein. But, it would be better to sell the oats, and feed in their place eight pounds of bran and a pound and a half of cotton seed meal. Such a combination would give the same quantity of protein and would cost less.

Question.— How about barley straw for feed?

Mr. Woodward.— It is much better than timothy hay, especially for sheep, provided the barley beards are out of it. The beards do not injure the sheeps' stomach, but they get into the wool, and are very difficult to dislodge.

Question.— Can you make a balanced ration for a milch cow, of oats, barley and timothy hay?

Dr. Smead.— No; it cannot be done. Such a ration would be wholly one-sided. Oats have a ratio of 1 to 6; barley, 1 to 8, while timothy has one of 1 to 14. The milch cows require one of about 1 to 5, so it is seen that there would not be protein enough in the ration. Leave out the barley and add bran or buckwheat middlings, or put in some gluten or linseed meal. I should prefer the bran and oil meal unless buckwheat middlings cost too much.

A Farmer.— We have to pay $18 per ton for them.

Dr. Smead.— Buckwheat middlings have a ratio of about 1 to 2, and at that price are fully as profitable as is the bran, and as we must have protein to balance the starch and sugar in the other foods, they will be found the cheapest of the protein foods.

Question.— Does the feed you give a cow make a difference in the quality of her milk, as well as in quantity?

Mr. Smith.— The cow will give equally rich milk when fed oat straw as when fed wheat bran, oat meal, gluten or clover hay. There are a good many farmers who do not believe it, however, and they say they know the cow will not do it. But they make the mistake of attributing an increase of butter fat to food, when the increase is caused by the shrinkage of the water in the milk. If such shrunken milk is tested by the chemists it will be found there has been a proportionate increase of the total solids, except the sugar, as well as of the fat. If I have a cow that gives normal milk, testing 5.5 per cent. fat, no change of foods will put any more fat into it. It is only when a cow is thrown out of normal condition that a change in the fat is observed.

Question.— What kind of mill feed would you buy for the milch cow, in connection with ensilage, bean fodder and straw?

Mr. Smith.— Price will determine. Where can you buy protein the most cheaply? That should be the question asked.

Question.— To what extent may bran be fed in connection with clover hay to our milch cows?

Mr. Witter.— It is a question that cannot be answered by pounds; individuality must be considered. We are feeding bran and clover hay, but we cannot lay down a special weight. All depends on the individuality of the cow and the coarse fodder used. We can formulate a ration for certain purposes, but we cannot tell you how much of it to feed.

Question.— Is gluten meal better than oil meal or oil cake, and where can we get it?

Mr. Smith.— No; it will not take the place of oil meal. It is a good food, when mixed with bran, but there is but little gluten meal on the market; what we buy for gluten meal is mostly gluten feed, in which, as a rule, corn bran has been mixed, a food having only 10 or 11 per cent. of protein. This greatly adulterates the gluten feed. If you can get good gluten meal at $20 to $21 per ton, it will be more profitable than will oil meal at $29. But there is a lack of mineral matter in gluten meal, and, when too much is fed, the "cow soon goes off her feed." We mix it half and half with wheat bran for our cows at the Geneva Station.

Question.— How about cotton seed meal?

Mr. Smith.— It is very rich in protein and constipating in its nature; therefore, it is unsafe to feed too much of it. I should not start with more than half a pound and would not increase it beyond two pounds per day.

Question.— Would it pay best to sell oats at 32 cents a bushel and buy bran at $17 per ton, to mix with gluten meal?

Mr. Witter.— I do not like to answer the question, for I dislike to sell anything off the farm which I know is good. Oats have a ratio of 1 to 6, nearly perfectly balanced, while wheat bran has one of nearly 1 to 4; but oats have another value known by some as nerve power, something the bran does not have. But, from a money standpoint, if a man has to draw his oats to the mill, it would, no doubt, be better to sell the oats and buy bran — at the prices named — if he has ensilage to feed.

Question.— Do you raise oats and peas on the Geneva Station farm to feed cows in summer?

Mr. Smith.— Sometimes, when we have a piece of land for which we have no other special use. We had such a piece last summer, but the dry weather nearly ruined the crop. We get more value from our alfalfa. If oats and peas are sown, the peas should be sown deeply, and there should be several sowings at intervals of 10 days to secure best results.

Question.— Which is most profitable, bran at $17 per ton or gluten feed, containing 27 per cent. protein, at $22 per ton; or should one use a combination of the two?

Mr. Van Wagenen.— We cannot tell what given foods to recommend until we know the nature and value of the coarse foods. We ought to make our food list as variable as possible. None of us would care to live on meat or bread or pie alone. Give the cow as varied a ration as possible. I think wheat bran is the best protein ration. A cow may go to a bin of bran and eat as much as she likes and not have it injure her. I think a combination of the two would, under ordinary circumstances, be preferable. If clover hay is fed, less of the combination should be fed than when timothy hay or silage is used.

Question.— Name a ration for cows. I have timothy and early cut oat straw. What else do I need?

Mr. Smith.— It will all depend on the cost of foods. If oats are high enough in price I should sell them and use the money to buy wheat bran or gluten. If those foods cost more than the oats would sell for, I should feed the oats. But one must always take into consideration the protein value of those foods and be governed accordingly. One should also take into consideration the amount of energy required to digest a food. It has been found that a cow was better off without oat straw than with it, and yet I am not saying that good oat straw is not beneficial when properly fed; that is, balanced with good protein foods.

Question.— Would you sow rape seed among the corn rows?

Mr. Van Wagenen.— If the corn makes a large growth it will require too much moisture, so that the rape does not get enough. Sometimes it will make a good growth after the corn has been taken off. I think, as a rule, the sowing of rape or clover in the corn has not proved a success. It is pretty hard to get two different crops off the same piece of land at the same time. When we get a growing fall, some benefit may be derived from the sowing of such crops among the corn rows, but it will all come after the corn has been taken off.

Question.— Are ground beans a good food for dairy cows?

Mr. Smith.— Beans are rich in protein, containing nearly 25 per cent. of it.

Mr. Smallwood.— Would it not be better to sell the beans for $2 per bushel and buy something else?

Mr. Smith.— As a rule, only split beans are fed to cattle.

Question.— Is corn meal and wheat bran a good food for horses or cows? Does it make a good ration?

Mr. Smith.— Yes; if properly combined with something else. If you are feeding clover hay, it will make a balanced ration; if timothy hay, the ration will be wholly unbalanced; there will be too much starch in such a ration. Corn meal would be required only with the clover.

Dr. Smead.— Two parts of bran, by weight, and one of corn meal for the working horse, will make a balanced ration. But, for the ordinary horse on the road the best ration will be found in oats fed with mixed hay; that is, clover and timothy, cut early.

Question.— Are wheat middlings as valuable as bran?

Mr. Woodward.— No; because there is flour in them. The cleaner bran is, the more value it has for feeding. A ton of pure bran is of much more value than is one of middlings. But there is much bran being adulterated; *terra alba* (white earth) is used; so are finely ground corn cobs. If you have suspicion that the bran is not pure, fill a drinking glass one-fourth full; fill with water and allow to stand awhile. If there is a white milky substance in the bottom of the glass, you may know the bran has been adulterated with some substance.

Question.— Would you feed clover hay to work horses and colts; if so, to what extent?

Dr. Smead.— Clover hay is better than the timothy, but to some colts but little of it can be fed, as it is somewhat constipating. Work horses may be fed more of it.

Question.— How shall we mix gluten and wheat bran?

Mr. Smith.— Half and half by weight. But, many of these foods are adulterated. The nearer we can get to strictly pure goods, the greater value for the price paid.

Question.— Are wheat screenings good as ground food, for cattle?

Dr. Smead.— Wheat screenings are unsafe to grind, as they are full of weed seeds. If you have such screenings feed them to the hens. They will pick out all that is good for anything, and leave the rest.

Question.— Does it pay to feed gluten meal that analyzes 39½ per cent. protein, at $30 per ton; how much at a feed?

Mr. Smith.— I have never seen any gluten meal as rich as that, in protein. If I had such meal I should not feed to exceed two pounds of it per day to a cow. I have never seen a gluten brand advertised that had such a guaranteed analysis, and do not believe there is one.

Question.— My herd is due to calve in about a month. I am feeding bean pods and hay. What should the grain ration be?

Mr. Smith.— For such a herd I should add some wheat bran to the pods.

Dr. Smead.— I should also add oats with the bran. There is a tendency to feed too many pods when a man has them. I should prefer to feed one to two pounds of oats, because of their added nerve power. Too much stress is laid on the value of a food to produce a milk flow, at the expense of the vital energy and nerve power of the cow. There should be some motive other than that to produce milk. The health of the cow and that of her progeny should be our first object; then may come the one of increasing the milk flow, if it can be done without injuring the cow.

Question.— With clover hay at $10 per ton, what are bean pods worth for feeding to cows?

Several farmers gave it as their opinion that a ton of good bean fodder was equal to a ton of clover hay.

Question.— What is corn stover?

Mr. Smith.— Corn stover is the stalks after the corn has been husked out.

Question.— Are beets profitable to feed cows? If so, what variety is best?

Mr. Woodward.— We grow beets; we also have silage, but we like to have a variety. We grow two varieties of beets, the "Long Red" for early, and "Golden Tankard" for late. We leave them 27 inches apart, and, as we grow them, the cost is not more than five cents per bushel. If one has no silo he should certainly raise beets; but every man who has a dairy should have two silos, one for winter, the other for summer feeding.

Question.— I am feeding nine fresh cows all the ensilage they will eat, with quite a liberal feeding of oat straw. The ensilage is rich in corn — they get 40 pounds per day. With milk at two and one-fourth cents per quart, would I have made any profit by feeding cotton seed meal or bran? I have no clover. The cows average 12 1/3 pounds of milk daily.

Mr. Smith.— That ration needs four pounds of wheat bran and three pounds of gluten meal. As it is, the cow will get only about six-tenths of a pound of protein, with five to six pounds of sugar and starch. The cow giving a good flow of milk requires two and one-half pounds of protein, daily, which she could not possibly get out of the ration described.

Mr. Woodward.— Those cows did remarkably well on the ration. They must have had some resources other than those named, as they could not take something out of the ration that was not in it.

Question.— What is the value of still slops, compared with ground feed, before the whiskey is taken out?

A Farmer.— It is asserted that a pailful of still slops has a feeding value equivalent to six pounds of corn meal. I figure their worth at 25 cents a barrel. We do not charge anything for hauling them.

Another Farmer.— I consider them the best feed ever fed to cattle. It makes them look sleek and keeps them healthy. The slops are made of corn and barley.

Another Farmer.— Eleven cows in four days, in my herd, increased their milk 35 pounds per day after I began feeding the slop.

To Mr. Smith.— What are the differences between, and the costs of gluten meal, gluten feed and corn bran? What are they made from?

Answer.— They are all made from corn out of which the starch has been taken. "Gluten feed" has about 27 per cent. protein. "Gluten meal" from 34 to 36 per cent. "Corn bran," another form, contains from 10 to 11 per cent. protein. As a rule gluten feed and corn bran are more expensive than is gluten meal. Such meal ought to be bought for $30 per ton, but it is deficient in mineral matter. So I should prefer oil meal at $2 more per ton.

Question.— How much shall we feed to a cow?

Mr. Smith.— That would depend on the cow. We do not feed an excess of eight pounds to our best cows.

Question.— What would you say of a ration for cows, not in milk, of two feeds of good ensilage and one of hay, daily?

Mr. Chapman.— I do not think the cow would object. A cow not giving milk, if she has ensilage twice a day and hay once, ought to do very well, unless there is too much corn in the ensilage. In that case, she might lay on too much fat. The ration as given here would hardly contain protein enough for a milch cow or a growing one.

Question.— What are the best foods for those who cannot have silos, nor raise clover to feed their cows?

Mr. Smith.— If a man has no silo and cannot grow clover, the cheapest and most profitable food for him to raise would be mangels. They will be more profitable than sugar beets, because there can be so many more tons grown on an acre?

Question.— Which makes the best milk and butter ration, oats and bran and gluten meal, or bran and gluten meal?

Mr. Witter.— I should prefer to mix the three. The cows all prefer a variety, and will respond better from it than from a single feed, although there is no more protein in it.

Question.— How much bran should be fed to a cow?

Mr. Gould.— How long is a string, or how big is a piece of chalk? It would depend on the cow; how large she was; whether she was in milk or dry, and what the coarse fodder was.

Question.— Can you tell us about rye hay? Who has had experience with it? When should rye be cut for hay, before or after heading?

Mr. Smith.— Rye becomes woody very early. If hay is to be made of it, it must be cut before it heads. At that stage it makes very good hay.

Question.— Is it a good crop to plow under?

Mr. Smith.— Yes; but it ought to be plowed under early in the spring. But rye does not supply any plant food. It does not absorb nitrogen from the air, as do the legumes; so that when plowed under, it only furnishes humus vegetable matter. But do not wait till it has headed out. Sow it among the corn rows, or later, and plow under quite early in the spring. If there is a too large growth, pasture it off a little in the spring.

Question.— What will be the best grain substitute for hay, when cows are dry?

Mr. Garrison.— Bran.

Mr. Litchard.— I should use one part corn and two parts bran.

Mr. Stevens.— Just one word on this point: I am a great believer in corn as a food for the dairy cow. Two of the best butter dairies in this country, both making dollar a pound butter, feed two-thirds corn and one-third bran. For dry cows, too, I believe the addition of corn will be found profitable, helping as it does to put them in good condition, and fit them for service when they come into milk; care being taken, of course, not to fatten them too much.

To Mr. Woodward.— What do you mean when you say "succulence?"

Answer.— Succulence is a juicy condition. The cows' food should have it. To illustrate: Mow 100 pounds of lawn grass and feed it directly to your cow. She will eat it, lie down, digest it and give you two pails full of milk each day. She does it, because that grass has about the nutritive ratio contained in the milk. Beside keeping up her milk flow, she gains in condition, every day. Now cut another 100 pounds of lawn grass, convert it into hay and feed it to that cow. Result — if nothing else is fed, the cow wlll not only cease giving milk, but will starve. What went out of that grass when you converted it into hay? Moisture, nothing more; but it was nature's moisture distributed throughout each spear of grass, thus making it succulent; when it was changed into hay, that succulence was driven out. No quantity of water added to the hay would have restored it.

Question.— I am milking a farrow cow; her feed is mixed; hay — all she will eat; two quarts of ground oats, and two of corn meal. How can I better the ration?

Mr. Smith.— By leaving out the corn meal and wheat bran.

Question.— We have but little clover; what would be a proper ration of grain for milk production?

Mr. Smith.— If you have timothy or mixed hay, feed four pounds of wheat bran, four pounds of gluten feed and one of linseed meal. That would make a good combination in the absence of clover. If you make the basis of your grain ration, wheat bran, there is not much danger of overfeeding. You can always tell when you are doing that, from the sour smell in the stable. Buckwheat middlings have a ratio of 1 to 3, so that not so many of them should be fed; they also tend to produce a soft white butter.

Mr. Woodward.— I should sell the oats, if I could, and buy bran. There is nothing so good as bran that I ever fed to my cows. A ton of bran is worth a ton and a half of oats, while the value of bran manure is much greater than that of oats. But, if I were so situated that I could not sell the oats, I should feed them.

Question.— What about "Kow Kure" and other "kures" and prepared foods?

Dr. Smead.— They have a basis of oil meal, with a little gentian and some other cheap ingredients to make them smell and taste good. The feeding value in them consists almost wholly in the oil meal; but these foods are sold at a price of about $400 per ton, while not costing much more than $30.

Here is the analyses and first cost of one of them which I found being retailed at the rate of $20 per hundred pounds, or $400 per ton:

100 pounds linseed meal	$1 30
6 pounds salt	05
2 pounds charcoal	10
2 pounds gentian	15

1 pound ginger	$0 20
2 pounds saltpetre	30
1 pound anise seed	15
114	$2 25

Question.— What is the value of bone meal for cattle?

Dr. Smead.— I should not feed it; it is too indigestible. Cattle can get mineral in a more digestible form in wheat bran.

Question.— What is the difference in the value of gluten meal and wheat bran?

Mr. Witter.— Gluten contains more protein, but is deficient in mineral matter when compared with bran. I should feed both together.

Question.— Will turnips injure a cow's milk?

Mr. Smith.— No; provided too many are not fed, and they are fed directly after milking. I heard a dairyman say at an institute recently that he fed his cows a bushel of turnips each per day. He makes butter which he sells to private families. No fault is or has been found with it.

A Farmer.— That is a big story, but he may have big cows.

Another Farmer.— That statement cannot be true. Such a quantity would surely injure the next milking; that is my opinion.

Question.— Can we afford to raise hay to feed cows, on land that will grow corn?

Mr. Bentley.— What kind of hay?

A Farmer.— I will say no, speaking from general principles.

Mr. Bentley.— I do not think that any farmer here can afford to plow up a well-established meadow and plant it to something else. The question of labor enters in too sharply for that.

Mr. Smith.— The average yield of timothy hay is less than one and a half tons per acre, or, say, 3,000 pounds. We get in 3,000 pounds of timothy hay about 1,100 pounds of starch; that is above the average yield in this State. In an acre of good silage corn there is from 5,000 to 6,000 pounds of starch. We feed both the hay and the corn for their starch element; therefore, we cannot afford to feed our cows timothy hay. No; plant corn, put it into silo and sell the hay, especially when you can get $12 per ton for it, as you can now.

Do you know what a pound of butter or cheese will cost, made from timothy hay at $12 a ton? The butter, taking the yield of the average cow in this State, will cost you 36 cents per pound, and the cheese 15 cents. But the average farmer in this State is doing just that sort of thing — keeping cows that give 3,500 pounds of 3.8 per cent. milk, feeding them timothy hay, corn meal and corn stalks, and allowing them to go dry three or more months in the year, when milk is worth most. If the farmer would only study the feeding question well, test his cows and keep only those which will pay for their keeping, and leave a profit, he would be much better off.

Question.— How large do you let Canada peas grow to plow under for a green manure?

Mr. Gould.— When the peas are nicely formed. Do not let the plant get woody. Roll it down in the direction you are to plow. Plow just deep enough to cover nicely. Roll thoroughly after plowing.

Question.— What is the difference between the Canada pea and the cow pea, and their relative value to the farmer?

Mr. Gould.— The cow pea is simply a bean. Both have the same characteristics. Both are legumes, drawing nitrogen from the air. Canada peas will withstand frost and are more palatable to cattle. We use cow peas as a catch crop. It is a quick growing plant and furnishes a large quantity of vegetable matter to plow under.

Question.— Does not corn meal fed with corn stalks and hay take the place of oil meal? If so, why?

Mr. Smith, in answering the question, said that the foods did not compare. Corn meal, corn stalks and corn produce fat. If too much of either be fed, there will not be enough muscle and blood-forming element in them. Oil meal is a protein food and produces bone, blood, muscle and milk. This element is deficient in corn. Oil meal contains nearly three times as much protein as does corn. Feed both, but in proper proportion.

CLOVER.

Question.— What is the comparative feeding value of clover and timothy for hay?

Mr. Smith.— It is difficult to compare two foods, because of conditions. But, in a general way, I will say that when clover hay is worth $12 per ton, timothy is worth $5.74.

Mr. Woodward.— I do not allow a man to sow timothy seed on my farm. I should much prefer Canada thistles, because, if they are cut before they go to seed and are properly cured, they make a very good hay. Timothy is not fitted for sheep. I have tried it many times, and do not want it to feed any animal on the farm.

Question.— When is the best time to cut clover?

Mr. Litchard.— I cut my clover just before the first blossoms close. We cut it after the dew or rain is off, allow it to wilt, then cock it and let it stand and cure. All we want is to get the surplus water out of it.

A Farmer.— Suppose we have a rainy season; then what?

Mr. Litchard.— Do the best you can and trust the Lord for the rest; but clover may be put in quite green if all the foreign water is out of it, the barn made tight and doors kept closed. I use the tedder. It is one of the best tools on my farm. It will get the water out of it quickly; when that is done we want to hustle the clover into the barn.

Mr. Smith.— At the Geneva Station we cut our clover just as soon as the dew is off or it has dried off after a rain. It is then allowed to wilt, after which it is raked and cocked, and paper caps placed upon them. They stand there until cured enough to draw in.

A Farmer.— Clover fails here largely (Niagara county). So we are sowing rye in its stead to plow under.

Mr. Witter.— Rye, when turned under, before it is too large, will furnish humus; but it does not add any fertility to the soil, while clover does, because it takes nitrogen from the atmosphere, stores it in nodules on its roots, then transmits it to the soil. Clover will not grow in an acid soil.

Question.— How can we make clover grow on poor land?

Mr. Rice.— There are two ways to get such land into condition to get a catch of clover. If you have manure and will apply enough of it so that it will make humus, if the soil is not acid, it will put it in proper condition. If you do not have the manure, sow cow peas or rye, and plow them under. There must be humus first supplied to hold moisture. Young clover is a tender plant and must have moisture, a sweet soil and a plentiful supply of plant food. When you have the vegetable matter in the soil, apply a good commercial fertilizer containing only a small per cent. of nitrogen, but rich in potash and phosphoric acid. By following this method we never fail to get a clover catch.

Question.— What is the reason we cannot grow red clover? It has been a failure here in Steuben county the last four or five years.

Mr. Woodward.— There are several reasons. One is the absence of humus, that is, vegetable mould in the soil to hold water; one pound of humus will hold four pounds of water. Another reason may be a want of potash and phosphoric acid; another reason is an acid soil, and still another is the presence of the clover maggot, which eats off the clover close to the ground as fast as it appears; and there is still another reason — not sowing early enough in the spring. Doubtless one or more of the foregoing is the cause of the failure.

Question.— Will it pay to sow clover seed that costs $7 a bushel?

Mr. Smith.— I do not believe you can afford to farm it in this State unless you grow clover, provided it will grow on your land.

Mr. Woodward.— I do not think that a man can afford to farm it without raising clover, if the seed is $40 a bushel. One reason for clover not growing on many farms is the sparing quantity of seed sown. Put on a plenty of seed if you want to get a catch.

Mr. Smith.— I think that there will be a better chance of getting a catch when the clover seed is sown alone. I have seen good catches when the seed was sown after a crop of oats and peas had been taken off in July. Sown at that season, if given the entire use of the land, the growth the next spring will be fully as great as of that sown the spring before.

Mr. Rice.— If you can get humus enough into the soil I do not believe there will be any difficulty in growing clover, unless the soil is acid.

Question.— Will it pay to buy clover seed at $6 per bushel to seed our land and plow under as a fertilizer?

Mr. Litchard.— Under some circumstances it might. It certainly will not pay to buy poor seed, even at a reduced price. The greatest mistake a farmer can make is to buy a cheap grade of clover or timothy seed. Buy the best or none at all. The great value of clover as a fertilizer is in its roots. The little nodules on the roots of the clover plant are nitrogen gatherers, and on their power to gather nitrogen from the atmosphere and deposit it in the soil depends its value as a fertilizer. I don't want anything better for a corn or potato crop than a clover sod. Alsike clover is better for a wet soil than the common red clover, and, instead of being a biennial, like the latter, it is a perennial, and when once established, will, under favorable conditions, remain in the soil for a series of years.

Question.— Which is the best way to sow medium clover seed to secure a good catch?

Mr. Gould.— Different localities have different methods. With us, in Ohio, as a rule, clover is sown with oats. My best success has been obtained when sowing clover alone, just after the 4th of July, and giving it the whole use of the land. It makes a good growth and goes through the winter safely. When clover is sown with another crop, the moisture it should have is diverted to the other crop.

Question.— When is the proper time to sow red clover seed?

Mr. Chapman.— We sow clover seed in the spring, on our winter wheat. When conditions are just right we have succeeded. During the last three years, however, spring-sown clover has failed. We now fit the land well and sow the clover and timothy about the 1st of August. It succeeds very well, so that the next year we get as good crop as when we succeeded in spring sowing. We get a little better crop of grass when cut a little later, than is grown from spring sowing. We sow about six quarts of clover and ten of timothy seed per acre.

Question.— How late would you sow crimson clover seed?

Mr. Rice.— Not later than the 1st of August. We sow it from the last week in June to the last week in August; but we prefer not to wait later than the latter part of July.

Question.— Will it pay to sow grass or clover seed alone, without any other crop?

Mr. Cook.— We have done it many times; there is no question that if the seed is sown early enough, and the soil has been well prepared, it will prove a success.

Question.— For light loam soils seeded with crimson clover, which would be the most profitable, to plow under the crop green, or to cut and sell the seed?

Mr. Smith.— I do not think we can profitably grow crimson clover seed. Crimson clover is sown for a catch crop to be plowed under.

Question.— How should clover seed be covered when sown alone after growing oats?

Mr. Smith.— You may cover the seed, either with the weeder or smoothing harrow.

Question.— What crops are best to precede clover?

Mr. Rice.— We got an excellent catch of clover after taking off a crop of early potatoes. We plowed the land and then sowed on dissolved South Carolina rock and seeded it to clover. We sowed just enough buckwheat to shade the young clover, but not enough to detract moisture from the clover. I never saw a better catch of clover than the one we got.

Mr. Woodward.— We got lots of clover last year. We have no trouble. There are four conditions necessary to grow it: First, humus; second, potash; third, phosphoric acid; and fourth, there must be no acid in the soil. These conditions furnished, clover will grow just as well as it ever did. The greatest trouble is a lack of humus. Stable manure and the turning under of green crops will furnish humus, but green manures are too costly with me.

Dr. Smead said that he believed there was some condition we did not understand which prevented clover from growing. He once plowed up an old lane in which cattle had stood for years. The ground was full of humus, but he could not grow clover on it.

Mr. Woodward.— Probably there is too much nitrogen in the land. I once moved an old barn, but could not grow clover or hardly anything else on the ground where the barn stood. The cause was too much nitrogen. Clover will not grow where there is an excess of it.

THE DAIRY.

Question.— What is the best floor for cows, earth, cement or plank?

Mr. Irwin.— We use a combination of stone and clay. We have used it several years. It has cost but little for repairs and has given us excellent satisfaction.

Mr. Smith.— We have cement floors at the Geneva Station, but plank was cemented into them when the cement was laid. We like such floors better than those made wholly of cement. The cows are tied singly, but they have all the room they need and are fastened with a short chain, which gives them liberty to turn about in part, and lick themselves.

Question.— How shall we manage to get a better price for milk at the stations?

Mr. Smith.— The milk stations are paying, as usual, a very good price. It has been found, and is now, a hard problem to settle, but we know that it could be solved in one way at least. The farmers must combine and establish the shipping stations and factories. When they do this, they can control the price; not until then; because they will be able to hold back the surplus milk and turn it into cheese and butter. But, when the price of milk is advanced to a point above its value for butter and cheese, the farmers desert the factories and flee to the stations, whereupon down goes the price for shippers' milk. At $1.24 per hundred pounds for milk, the Cheddar cheese factories cannot afford to take it. The Five States Milk Producers' Association is trying to devise some system by which milk producers can get a better price for their milk, and not increase the price to the consumer, which ought not to be done.

A Farmer.— Milk is worth at least $1.40 per hundred for making Limburger cheese.

Mr. Smith.— Possibly; I do not know anything about the local Limburger market; but, for Cheddar cheese for export or home market, milk is not worth now $1.24 per hundred pounds. In some localities the shipping stations put up the price and then close up the factories and creameries; afterward they dropped the price.

Question.— Is it desirable to dishorn cattle? It so, at what season should it be done?

Mr. Cook.— How many of you believe it is desirable to take the horns off?

A large majority favored the operation.

Mr. Cook.— We take the horns off our cows before they drop their first calf — doing the work in winter or before the 1st of April; using clippers instead of the saw. The secret is in getting down close to the head.

Dr. Smead.— Prejudice goes a long way. I was once greatly prejudiced against dishorning, but have got over that. The pain experienced by the cow is no greater than yours or mine when a tooth is drawn, merely momentary. There is no pain in the hemorrhage which follows the operation. To stop the flow of blood saturate a little cotton with tar and spread it over the stump of the horn; do not turn the animal out when the weather is cold, until the wounds are nearly healed.

Mr. Cook.— It will take about six weeks to heal the wounds.

To Mr. Gould.— Would you advise the crossing of a Durham cow with a Jersey sire?

Answer.— No. Why should one do that? The two types are too wide apart.

Question.— If the milk of a cow tests 3 per cent. fat, how many pounds should she give in a year to make her profitable at present price of feed?

Mr. Smith.— If she gave 9,000 pounds it would mean 270 pounds of fat. If we add 15 per cent. moisture, there would be about 320 pounds of butter.

Question.— How much butter will 100 pounds of butter fat make?

Dr. Smead.— As a rule, butter contains 15 per cent. moisture; that gives 115 pounds of butter.

Question.— Does it pay to warm water for cows?

Mr. Woodward.— No, sir. It costs too much for fuel and labor. If the cows are furnished with water so that they can drink at any time, they will take it 20 times a day. Such an arrangement for watering the cows in the barn in winter will prove of much more benefit than warming the water.

Question.— How long before a cow drops her calf should we cease milking her?

Mr. Woodward.— If she wants to give milk, milk her right along, if she drops her calf in the afternoon after milking her in the morning.

Question.— Would you use the last milkings?

Mr. Woodward.— You may know when to cease using the milk. When it curdles if boiled, it is unsuitable to use for food, although some people use it right along, or, when the cow has been dried up, use the first milking for food.

Question.— What can be done for a cow that bawls most of the time? She is isolated from other cattle.

Mr. Woodward.— The cause is loneliness or homesickness. If she is put where she can see another cow, she will cease to "bawl." I had a cow that was isolated, and she soon commenced bawling. I placed her where she could see a horse, and she at once stopped. Animals, as well as human beings, get lonesome and homestick.

Question.— What is the reason that Canada cheese commands a better price and sells higher than does New York cheese?

Mr. Smith.— It does not always sell for more. There are thousands of tons of cheese made in New York that sell for as much as does Canada cheese, if the difference in freight is deducted, both going to the Montreal market for export to Europe. As a rule, the last season, there was not more than an eighth of a cent difference between the Watertown, N. Y., and the Brockville, Canada, prices, and this difference was made because of additional freight charges.

Mr. Jennings.— On two sales days at the Watertown board of trade last summer, Jefferson county cheese outsold that of the same date on the Brockville board, but it was purchased for home consumption, while the Brockville cheese was for export.

Question.— How many cows can be kept on 50 acres of land?

Mr. Smith.— It would all depend on the man. One would not keep more than five, while another would keep 50.

A Farmer.— I can keep 25 cows on 50 acres on my farm.

Question.— Which breed of cows is the best?

Mr. Smith.— I do not know. There are good and poor ones in all breeds. It will all depend on the man who owns the cows and what he wants them for. But, whatever breed you select, be sure to invest in one of the dairy breeds. Do not undertake to mix beef and butter together. One must make a selection to suit him and for the purpose he wants the herd. We are not here to advise which breed to select.

Question.— Do you believe that all cows can be made to give milk the year round?

Dr. Smead.— No, but there are many cows that do not go dry. Much depends on the breed and ancestry. A cow to be profitable ought not to give less than 5,000 pounds of milk per year, containing not less than 4 per cent. butter-fat.

Question.— In how small a dairy can a cream separator be used?

Mr. Smith.— It would depend somewhat on the cows, whether they give much or little milk, and whether they milked nearly all the year or were dry all winter. At the prices at which the small machines are now sold, one ought to pay well in a dairy of five or six cows. Nearly all the various makers of separators build small hand machines, the prices of which are much lower than they formerly were. All are good, and will skim down to, or below, one-tenth of 1 per cent. fat.

Question.— How often should a cow be given water? Before or after feeding?

Mr. Goodrich.— Follow nature. They naturally want to drink as soon as they have eaten. We have watering devices in the stable and we have noticed that the cows always drink after eating any food. If you will examine the cow's cud you will see it is soaked in water. So, then, give her all she will drink, that is, when the food is dry. She will not require as much when she has green food.

Question.— At what season would you have a cow freshen?

Mr. Goodrich.— Have the cow freshen in the fall. She will give 1,000 pounds more milk in a year than when she drops her calf in the spring. Then, too, the winter is the best season of the year in which to raise a calf.

Question.— At what age should a heifer drop her first calf?

Mr. Goodrich.— Have the heifer drop her first calf when she is two years old. Do not allow that heifer to put on fat from calfhood to motherhood. If you do, when you ask her for milk she will say, "I can't do it; you taught me to put on fat when I was a calf. I cannot give you milk now."

Question.— Do bunches or sores on milch cows in any way affect their milk?

Mr. Smith.— Do you want to eat milk from a cow that has a running sore?

Several answered No.

Mr. Smith.— A cow that has such a sore is diseased. Her milk ought not to be sent to a factory or creamery. No matter where the sore is, such a sore is caused by some diseased condition of the blood, therefore, the cow is not in a healthy condition, and the milk is not in a healthy condition. The cow should be in good health and free from all disease. When one portion of the animal is diseased the whole system is more or less affected.

Question.— Why do cows chew bones and old leather?

Dr. Smead.— As a rule, it is caused by a sour stomach, or what we call acidity. Salt and some powdered charcoal will correct the acidity. Sometimes it is caused by a lack of mineral element in the food.

Question.— Does it injure a cow to have the calf suckle her four weeks after calving?

Mr. Goodrich.— I have practiced allowing the calf to suckle the cow for that period, but to my sorrow. I now take it away as soon as I can after it is dropped; that for the good of the mother.

Question.— Which is the most profitable cow for the farmer, the grade or full-blood Holstein?

Mr. Van Wagenen.— The most profitable cow is the one which will produce the most butter fat for the cost of the food she consumes; but, to say that a grade or thoroughbred is the best, is begging the question. The record for best butter production by one cow is held by a Holstein, although, as between the breeds —

Jersey and Holstein — perhaps most butter has been produced by the former.

Question.— Do you think that a herd with an average of 7,000 pounds per cow is a good starter?

Mr. Gould.— As long as the average cow only produces 3,500 pounds of milk per year, I should think the man who had a 7,000 pound herd would imagine he had a starter, certain.

Question.— Which breed of dairy cows do you recommend?

Mr. Goodrich.— The one you like best. If a Jersey, get her; if a Holstein, select her; or, if you prefer a Guernsey, tie to her. Then stick to her. Don't mix them up and go from one to another.

Question.— Can you give the butter record of Brown Bessie, at Chicago?

Answer.— She made 216 pounds of butter in the 90-day test. During the last week she made three pounds of butter per day. I do not think, however, that those cows were properly fed. My idea is that a milch cow should have twice as many pounds of coarse fodder as of grain. Brown Bessie was given 20 or more pounds of grain per day, which would require 40 pounds of coarse food, a quantity she could not store and digest. Those crowded cows have never done much since, so far as I have been able to find out, and I have made a pretty thorough inquiry.

Question.— How long should a cow go dry for best results in milk?

Mr. Lillie.— We do not care to have a cow go dry more than four or six weeks. If she develops a tendency not to "dry off," we milk her right along. If the cow has been bred so as to want to give milk right along, give her good, nutritious foods and allow her to do it.

To Mr. Goodrich: Question.— Why do you say that a cow will produce more milk when she freshens in the fall?

Answer.— I said that a cow will produce more milk when she comes fresh in the fall. Of course, I assume that she must be well fed. As a rule, the cows that go dry in the fall are not very well kept in winter. Another point is, when the drouth comes in July they shrink their milk flow, which cannot be got back, so that they go into the winter giving but little milk. If they are allowed to go dry in July and August, when the flies are numerous, and drop their calves in September or October, provided they are well kept through the winter, I know that there is the difference I mentioned.

Question.— How long should a cow be left out of doors in zero weather?

Mr. Smith.— I doubt very much if a farmer can afford to turn out a cow he is milking in zero weather. If he does, she ought to be put back again as soon as possible, provided he has good stables. It requires heat to maintain a cow, and it is much better to provide good quarters and water in the stables than to buy food to do it. But, if one's stables are so constructed that a cow is as well off outside as in, she may as well be out.

Mr. Lillie.— We have arrived at the conclusion that a cow giving milk ought not to be allowed out when the temperature is below the freezing point. It will be found much cheaper and better in the end to put some watering device in the stables. Put the cows into the stables as soon as the weather becomes cold and freezing and keep them there in such weather.

To Mr. Lillie.— Which do you consider of greater importance for future breeding, the sire or dam? Why are registered animals to be preferred?

Answer.— As a rule, the farmer places too much dependence on the dam. It should be on the other hand, because the sire possesses one-half the value of the herd. The farmer may have 50 cows, all good ones, but the bull may be worthless as a getter of future stock, and the trouble is that one cannot always tell whether that bull is a prepotent one or not, no matter how good his pedigree is. So it pays to record animals. In this way one may go back and find out something about the individual excellencies of the dam or sire he is going to use. It is a simple matter to test a cow, because we can use the Babcock test and scales; but to test the sire one must go slow. Use him on a few of the best cows of your herd and note the results. It is a great risk, and one must go slowly. You may get a sire that will do much good. The next one may undo all he has done for you. When you do get a good one, keep him. Don't sell him because he is growing old, or is becoming ugly and vicious.

Question.— What remedy is best to keep flies off our cows?

Mr. Smith.— I don't know which is the best. There are a number of remedies. One is "Shoofly;" another is "Nofly." Fish oil and carbolic acid will keep the flies away, but it is a "nasty" stuff, and must be rubbed on. It makes the hair look bad.

Dr. Smead.— I have used every remedy known and have settled down to a common spray pump costing 50 cents, from which

I spray crude petroleum, or tobacco water, or any other of the remedies. But it only keeps the flies off a few hours. One will have to spray his cows at least once a day if he wishes to keep off the flies.

Mr. Smith.— The mixture made of fish oil, carbolic acid and tobacco stem water, if rubbed on, proved the most really effective remedy used at the Geneva Station farm.

Question.— Which is the best cow for the dairy, the large or small one?

Mr. Woodward.— The cow that will pay the most for what she consumes; so it would all depend on the cow.

Question.— Would you feed the same ration to a cow for butter as you would for milk for market or for cheese?

Mr. Rice.— Yes, sir; with just an exception. In making butter, some foods will affect its quality and texture, which would not affect the milk. To illustrate, when corn meal, timothy hay or cotton seed meal are fed, the butter is hardened. When clover hay, gluten meal, oil meal and wheat bran are fed, the butter will be softened. But these foods will not influence the quality of the milk, one way or another, for cheese.

To Mr. Goodrich.— Is it not true that at Cornell they produced a good flow of milk from an almost carbonaceous ration?

Answer.— I do not know. Have seen no report of it from there.

Mr. Van Wagenen.— I am somewhat familiar with the work at Cornell, but have seen no such report. It is certainly economy to use something to balance a ration. A cow giving 30 to 40 pounds of milk a day ought to have two and a half pounds of protein, which she cannot get from sugar and starch, unless she is forced to eat more than she ought.

Question.— When is the best time to feed cows grain?

Mr. Van Wagenen.— Feed the dairy cow some grain every time she gets other food. The old way was to feed the cows three times a day; some, however, prefer twice.

Question.— Can the quality of milk be improved by feed, or must we depend entirely on the breed?

Dr. Smead.— A good quality of food will produce better milk than poor foods, but feed will not make a good cow out of a poor one; do the best we can. Now comes the question of quality of cow. If one has been fed up to her normal capacity, no amount of feeding will increase her per cent. of butter fat. If it would, there would be no trouble in making a first-class cow out of a scrub. So, then, if we are to get a first-class cow we must either buy or breed her.

Question.— Can a dairyman feed a full grain ration of eight or ten pounds to a cow with feed at $1 per 100 pounds, and sell his milk at 80 cents per 100 pounds?

Mr. Smith.— It would depend wholly on the capacity of the cow. We had three cows at the Geneva Station, all weighing nearly the same. It costs $47.50 to keep each of them. In winter they were fed 40 pounds of ensilage, 6 pounds of hay, 4 of wheat bran, 4 of malt sprouts and one of cotton seed meal. In summer they were fed alfalfa instead of ensilage. One cow was a full-blood Jersey; the second one, seven-eighths, and the third one a half-blood. The first one returned a profit of about $50; the second one, $11.90, while the third one returned a loss of $11.23; figuring the cheese at nine cents per pound, had it been made from the milk. So you see it all depends on the individuality of the cow and owner.

Question.— Will corn meal increase the richness of milk, or affect its flavor?

Mr. Smith.— No. There is not protein enough in corn meal to supply that required in milk. So that if the milk flow is to be kept up, food containing the same elements found in the milk must be given. When a cow shrinks in her milk, the part that goes out is the water. So it would seem that the per cent. of butter fat had been increased; but the other solids, except the sugar, have increased in the same ratio. If a cow has been starved to a point below her normal capacity of butter-fat production, she may, by judicious feeding, be brought up to it, but not beyond it.

Question.— Will any feed enrich a cow's milk? If so, what kind?

Mr. Smith.— I wish some one would tell me what kind will do it. I shall be glad to know.

A Farmer.— Green clover hay will do it. I have tried it and know.

Mr. Smith.— You have done something no one else has done. Here are the records of three of the Geneva Station cows; if you will feed them so as to increase the fat in the milk of either of them I will make you a nice present. No cow which has been fed up to her normal capacity of butter-fat production can be so fed as to increase the per cent. of fat. But, if the cow has been ill-treated and starved to a point below that normal capacity, she may be fed up to it. The best of the three cows at the Geneva Station gave 8,000 pounds of milk containing 5.6 per cent. milk. No amount of feeding will increase that per cent. of fat. The second cow gave 6,000 pounds of 4 per cent. milk, and the third one, 4,600 pounds of 3.8 per cent. milk. Now, no amount of feeding or increase of foods will increase the flow or fat per cent. up to that of the best cow. I made a long, thorough trial, but failed to do it.

Question.— Which is best, to keep a cow in the barn all the time in winter or out of doors a part of the time?

Mr. Gould.— Is the cow giving milk, is she dry, or coming in in the spring? If the stable is clean, dry, light and warm, I don't know what she should go out for. On the other hand, if the stable is dark, damp and ill-ventilated, it were better that the cow were turned out. My cows don't get exercise in the winter. They get all they want during the other eight months.

Question.— Am keeping but one cow. If I feed grain, which is the best and how much should be fed per day, every day in the year? Should she have a change 30 days before dropping calf?

Mr. Smith.— If a man has but one cow he cannot have ensilage, so I would say feed clover hay, wheat bran and corn meal. Would not feed timothy hay or buckwheat middlings to her. Oats and peas with barley make a good ration, with clover hay.

Question.— Is the Short-Horn a good breed for the dairy farmer? Are they good milkers?

Mr. Smith.— No; that is, the present strain of Short-Horns is not. Several years ago there was a family of excellent milking Short-Horns, but the breeders of them got into the craze of trying to breed beef and milk both into the same carcass, and the result is a breed of beef animals, as a rule, the milk product having disappeared. It is only occasionally that we hear of a good Short-Horn milking cow.

Question.— Is there a good dual purpose cow; if so, in what breed?

Mr. Smith.— Do any of you know a cow which can be fed a ration which will make a good flow of milk and at the same time a good beef cow?

A Farmer.— She will be a "freak" if you do.

Mr. Smith.— The dairy cow must be a special purpose cow, one bred for the production of milk. It is impossible to have such a cow as a good dual purpose one. The breeds are either beef or milk. The Short-Horn, Herefords and Angus are of the beef type; the Jersey, Guernsey, Holstein and Ayrshire are dairy breeds. It is the same with horses; one cannot make a trotter out of a Clydesdale.

Question.— When should a cow come in to milk to give the most milk during the year?

Mr. Witter.— In September or October, but she must be fed and cared for in the right way. She must have a warm stable, balanced ration and succulent foods; then we can get 25 per cent. more milk, if the cow comes in to milk in the fall.

Question.— Would a cow giving 5 per cent. milk need different feeding from a cow giving 3 per cent. milk?

Dr. Smead.— No; you cannot feed butter fat into the milk when you get her up to her normal production.

ALFALFA.*

Question.— Can alfalfa be successfully grown in this part of New York (St. Lawrence county)?

A Farmer.— It has died out here, the first year, so far.

Mr. Chapman.— In Onondaga county a good deal of alfalfa is grown, having taken the place of clover. It withstands the drouths. I sowed some last year. It looked very well when it went into the winter. Do not know how it will come out in the spring. Think we all ought to experiment with it. If it succeeds it will be found a very valuable forage crop. It is a deep rooter and ought not to be sown on wet land. Cut it when it first begins to show blossom, else it will become hard and woody. At Geneva, nearly four tons of cured alfalfa were cut from an acre, or about 17,000 pounds of green fodder. We allowed our calves to run on ours a little while last fall. When once it is well established it will last many years.

Mr. Goodrich said he knew of a piece that has given annual crops nine years and is in good condition now.

Question.— What about alfalfa? Is it all right for this climate and soil (Steuben county)?

Mr. Dawley.— Alfalfa is all right, but whether it can be grown here is a question. If you have never grown any, try a small piece of it. If it succeeds, sow more, make the ground rich and have it as fine as for an onion bed; then sow 30 pounds of seed on an acre, about the time you sow oats. Do not sow any other crop with it. We tried the soy beans and cow peas, but they did not succeed. Last year we made four cuttings of the alfalfa.

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* Read special article on this subject elsewhere in this volume.

Question.— Do you put it into a silo?

Mr. Dawley.— No, sir; I believe that the one crop for the silo is corn.

Question.— Will alfalfa grow in this locality (Oswego county)? If so, what kind of soil is needed?

Mr. Smith.— I don't know what your soils are. Alfalfa cannot be grown on too dry a soil, nor on one where water "backs up" and stands during the winter and spring. We grow alfalfa at the Geneva Station on a heavy clay soil, but it is well underdrained. Alfalfa requires a deep rich soil, with sufficient moisture, as it must have that as well as room for the roots to go down and spread out. But alfalfa, to be just right, must be cut before any of the seed develops, else the stalk becomes hard and woody and the leaves drop off. We sow about 30 pounds of seed per acre, without any other crop, and top dress the crop every two years.

A Farmer.— I sowed some alfalfa seed after peas and oats. It came up well and grew nicely till about July, when it turned yellow in color and died. Two or three farmers said their alfalfa had failed.

Mr. Smith.— If there is an acid condition of the soil, alfalfa will not grow. Test the soil with blue litmus paper. Every farmer ought to do it. It is an easy thing to do. Insert a small piece of it in the soil and leave it an hour. If the color has changed to a dull red, the soil is acid. A dressing with a ton of good carbonated lime (air slaked) per acre will sweeten the soil. Prof. Wheeler of Rhode Island, recommends an application of 2,500 pounds of such lime, once in four years, per acre. Red clover will not grow in acid soils.

Question.— Which variety of alfalfa is considered best?

Mr. Smith.—"Turkestan" is said to be the best, but it is difficult to obtain the seed, as it is not grown to any extent in this country, but is imported. As a rule, much of the imported seed is badly adulterated with a small, white, wild, foreign clover. "Turkestan" is said to be grown in some parts of the West, and the seed is said to be kept on sale by some dealers. If you buy it, patronize only first-class houses and insist on guarantee of purity.

Question.— What is good alfalfa hay worth per ton?

Mr. Smith.— It is fully as valuable as red clover and is rapidly becoming the favorite hay for many feeders.

Question.— What soil is best adapted for growing alfalfa?

Dr. Smead.— The soil should be dry; that is, there should not be soil water present, but there should be moisture, as the plant needs it, while the soil should be in such condition as will give the plant an opportunity to root well. It should be well fitted and the seed sown alone. Do not sow it with any grain crops. Try a little of it and watch results; if favorable, sow more. But do not become discouraged if it does not make a large growth the first year, as the young plants are delicate and look feeble. If it grows and weeds appear, go over the field with a mowing machine and clip the whole mass a few inches above the ground, and leave it for a mulch. The next year, if the alfalfa survives the winter, two or more cuttings may be made.

Question.— Is it as good as clover for hay?

Dr. Smead.— It is richer in protein than red clover, and a much larger tonnage can be raised; but to get the best value it must be cut just as the first blossoms appear, else it will become hard and woody and the leaves will all fall.

Question.— Where can we get alfalfa seed that will prove reliable, and what does it cost?

Mr. Dawley.— It has cost not far from $6 per bushel. Buy the seed from reliable dealers, those who will guarantee it to be clean and pure. Much of the seed we get is imported and is badly adulterated with a small variety of foreign clover which is worthless.

A Farmer.— Would it not be better to sow oats with alfalfa seed?

Mr. Smith.— No, sir. The alfalfa needs all the fertility and moisture in the soil. I should not handicap it with any other crop. Give it the entire use of the ground the first year.

Question.— How long will alfalfa last when there is a good catch?

Mr. Dawley.— That is a long question. I know of one piece of alafalfa that has been annually mowed for 21 years. Last season it was mowed three times. Another man near me owns three village lots, less than a half acre, on which he annually grows enough alfalfa to feed a milch cow every day in the year. There are many acres of it grown in Onondaga county. Some of the fields are underlaid with limestone. I know a field on which there is not two feet of soil over the rock, but the alfalfa grows all the same. Men who were quarrying stone near-by found alfalfa roots 18 feet long in the crevices of the rocks. Our alfalfa meadows produced four crops, last year, while our red clover was ruined by drouth. We did not even cut it. We never used any lime in our town as a dressing until we began using it for sweetening the soil before sowing alfalfa. It not only sweetens an acid soil, but helps to release locked-up fertility. If you have not experimented with alfalfa, begin with a small piece of it. Fit the ground as well as for onions. Sow at the rate of 25 to 30 pounds of seed per acre, and then await results. If it succeeds, sow more.

Question.— Would it be advisable to seed with alfalfa on low, sandy land, which has a clay subsoil?

Mr. Smith.— It would depend on the condition of the soil. If there is free water — subsoil water — present, alfalfa will not grow. Its best home is on land which has an underlying strata of lime rock. In some parts of Onondaga and Madison counties, it is the best hay crop. We prepare our soil by making it very fine and sow the seed — 30 pounds to the acre, using a wheelbarrow seeder — which broadcasts the seed. No other crop is sown with it; all the ground being given up to the alfalfa. About May 15 to 20, with us, is the proper season to sow the seed. The first season we run the mower over the field and cut down the whole mass — weeds and all, when it is about a foot high. The last cutting we save for hay.

Mr. Smith.— At what stage do you cut it?

Answer.— Just as it begins to blossom.

Question.— How do you cure it?

Answer.— We cut it after the dew is off; allow it to wilt a little, then put up in large cocks over which we spread canvas covers. The cocks are allowed to remain three or four days, when they are opened up, allowed to dry out a little, and are then put into the barn.

Question.— How long will it remain in the soil?

Mr. Smith.— We have one field of it on the Geneva Station farm that is 13 years old, in good condition now.

Question.— Will alfalfa "catch" and make a good growth if sown with oats in the spring on a thin sandy land?

Mr. Smith.— No, nor on a good soil, if sown with oats. It is a tender, feeble-growing plant at first and must have the best conditions to give it a start. Make the ground rich; do not sow any other seed with it. Give it the whole use of the ground, and make every condition as good as possible. If it survives the first winter, it will become well established and so remain a permanent crop for years.

Question.— Shall we sow it in the fall?

Mr. Smith.— No; sow it about the time of corn planting. I should not sow it later than the first of July. The plants must have time to make sufficient root growth the first year, else they will kill out in winter.

Question.— Is it not difficult to plow an alfalfa field?

Mr. Ward.— Yes; the roots are large and extend deeply into the soil. But, why plow it up? Once you have it well established, there is no other protein crop so good, nor one that will remain so long in the soil, at the same time producing so much each year.

Mr. Woodward.— If you are fortunate enough to get a field well established, keep it as long as you can. Top dress it every year and leave it alone. I saw a field of it in Canada that was 20 years old, and was, the owner said, as productive as ever.

Question.— What are the advantages of raising alfalfa?

Mr. Smith.— First, you get a larger growing material crop than from any other source except corn. We have taken off more than six tons of dry matter from an acre. It must have a dry soil; that is there must be no free soil water in it, and the ground must be rich. Six tons of dry hay cannot be produced on poor land.

Mr. Woodward.— Another advantage it has over other clovers is its permanency. Once it is well established it will last for years. I know one field that has been mowed more than 20 years, and it seems to be as good as ever, but it has been well fed every year with a good top dressing.

Question.— Is alfalfa profitable for producing milk, and when is the proper time to sow the seed?

Mr. Witter.— It is, probably, the best hay we grow. Alfalfa has a ratio about like wheat bran. With corn it is a valuable food for milk production. A limestone subsoil is best for it.

Question.— How long will alfalfa last before reseeding? Is it not difficult to plow up?

Mr. Smith.— We have a field of it at the Geneva Station that is 13 years old, which yields three to four crops per year, depending on the season. We had a small field that was not thick enough, and so plowed it last year. Three horses did the work easily. If, however, you get a good catch, keep it. Do not plow it up. There is no other protein crop grown to-day that will give you as great value as this crop.

Question.— Would it be good to grow alfalfa for hay in Delaware county?

Prof. F. H. Hall.— Yes; it certainly would be good, if it can be grown there. This is a question you can decide only by testing it, but I believe it is worthy of a trial. There is a wide range of choice in soils, on which it can be successfully grown. The essential thing is to get a good seed bed, and this you can afford to do, for unlike most other fodder crops, instead of being sown for a short period of one, two, or three years at the most, it is sown for ten years, or more, if it does succeed. Prepare the soil carefully, then sow from 18 to 30 pounds of seed to the acre. The stronger the soil on which it is sown, the more seed is required.

Question.— How do you feed alfalfa, green or dry?

Mr. Smith.— Both ways. We begin cutting it when it is a foot high to feed green, and continue until the first blossoms appear; then we cut the remainder and cure it for hay; when it reaches the same height again, we repeat the process, making in some seasons, four cuttings, depending on the season.

Question.— Can the land be plowed after being seeded two or three years to alfalfa?

Mr. Smith.— Yes; but when one gets a good catch of alfalfa he will not want to plow it up. We have plowed it, however, using three horses. The roots were very long and as large as my finger in diameter.

POTATOES.

Question.— We have cut down a number of our apple trees owing to the work of the canker worm. A part of the land was planted in corn. The crop was good. Another part was planted in potatoes, but the crop was small and scabby. What was the cause?

Mr. Van Alstyne.— It may be that there is too much nitrogen present. The large crop of corn would indicate it, also the small tubers; but it would not cause scab. Either there was scab present in the soil or in the seed potatoes you planted.

Question.— Would you plow early or late for potatoes?

Mr. Fenner.— For early potatoes, early; for late ones, not until about the time to plant them. We often plant late varieties as late as July 10th. From June 10th to July 10th is our time for planting those varieties. We plow the land just before the time to plant, roll it down hard, then make it very fine — as fine almost as for onions. The cultivation is done with the weeder and smoothing harrow — harrow first, followed by the cultivator at a shallow depth.

Question.— Please mention a variety of early potatoes which yields well?

Mr. Chamberlain.— We prefer Bovee.

Mr. Woodward said his preference was Bovee, while one or two farmers named Early Sunrise and some others, as best. Mr. Woodward said there was not more than three or four days difference in the time of ripening of Bovee and Sunrise, but the yield of Bovee was much the greater, he having grown as many as 300 bushels per acre. The quality, too, is fully equal to, if not better, than is that of Early Sunrise.

Question.— Is flat culture a practical way of growing potatoes?

Mr. Woodward.— What do you mean by "flat culture?" I plant my potatoes at least four inches deep. The ground is furrowed, the seed dropped and a furrow turned over them; then I put on a harrow and level the ground. A few days later I go over them with a harrow, crosswise of the rows. Later the weeder is put on, and still later I use the cultivator at a shallow depth. It will "hill" the potatoes all that they require.

Question.— Can there not be too much ammonia in the soil for a good crop of potatoes?

Mr. Smith.— Sometimes we find a great growth of vine, but no potatoes in the hills. This is caused by an excess of nitrogen and a lack of potash in the soil. There is a law that always governs in the growth of plants. The element of plant food most lacking will control not only production, but quality as well.

Mr. Rice.— The same law governs in fruits; an excess of nitrogen produces an overgrowth of wood, which is soft and spongy. A lack of potash causes a deficiency in leaf, or color and sugar in fruit, while a lack of phosphoric acid will cause imperfect seed. Either one of these defects influences the crop or plant.

Question.— Is a rotation of first wheat, then clover, then potatoes a good one to follow?

Mr. Goodrich.— I think it is. It is about as I rotate crops. We give first, clover, on which we spread over manure as fast as made; potatoes and corn follow.

Question.— Should wheat, then clover, then potato crops be continued in rotation for years?

Mr. Goodrich.— I think it could be done, provided the clover was all returned to the soil; but I should be afraid to put in potatoes every third year. I should be afraid of getting scabby potatoes. You may treat the seed just as much as you please, but the scab will get into the soil where potato-growing is continued. So I should not plant potatoes quite so often on the same land.

Mr. Smith.— Mr. T. B. Terry of Ohio, has followed a three-year rotation, clover, potatoes and wheat, on the same land for years. He has no scabby potatoes.

Question.— Would salt be of any value to prevent scab in potatoes and furnish moisture in a dry season?

Prof. Cavanaugh.— I do not believe that salt will prevent the appearance of potato scab.

Question.— When ground is in good condition to grow clover, will it grow smooth potatoes?

Prof. Cavanaugh.— I do not believe there is any connection between the growing of smooth potatoes and clover. Potato scab is caused by a germ in the soil. If it is there, scabby potatoes will be the result, no matter whether clover or some other crop preceded it. Lime corrects an acid condition of the soil, but an alkaline condition is better for the potato. I should not plant potatoes on land on which lime had been applied, until at least two years had passed. Treating the seed potatoes in a solution of corrosive sublimate, two ounces in a barrel of water, a half hour, will destroy the scab germ. Have the water hot or warm.

Question.— Are small potatoes as good for seed as medium-sized, cut two eyes to a piece?

Mr. Chapman.— I prefer a medium-sized potato to a large one, if it is mature.

Question.— Which system will produce most potatoes to the acre — three feet apart each way, or three feet one way and fifteen inches the other?

Mr. Smith.— I don't know; it would depend on the season and other conditions. I don't believe that any iron-clad rule can be laid down for all soils, all seasons and all growers.

Question.— What is the best fertilizer for potatoes?

Mr. Smith.— The best fertilizer for potatoes is a good clover sod, well fitted.

A Farmer.— We don't want to plow up a good clover sod and plant potatoes on it.

Mr. Smith.— Why not? Clover will live not longer than two years at most. If, after a crop has been taken off, you plow under the aftermath, you will get a large quantity of humus as well as a good per cent. of nitrogen, which was stored in both the roots and tops. The potato needs moisture, to get which there must be humus — vegetable matter — in the soil. As a rule, there is potash enough in the soil, and, if there is a good clover sod, nitrogen enough to grow a potato crop. If you want to add a commercial fertilizer, apply South Carolina rock.

Question.— What is the cause of potato scab? Is it a potato disease or a soil condition? What is the cure?

Mr. Rice.— It is a parasitic disease. It prefers an alkaline soil, one that has lime in it. If the soil is acid, the disease will quickly die out. I know of no absolute way by which the scab can be entirely eradicated in a soil where it has become really established. Sulphur is used in the potato hills. We also soak the seed in a solution of two ounces of corrosive sublimate dissolved in two gallons of water, one hour; take them out, allow them to dry, then cut for seed. This will eradicate all the scab, if there is any on the potatoes. I have never used the formaline treatment, although it is recommended by the experiment stations. It is preferable, however, to change the field for potatoes every year, to avoid scab getting into the soil, which soaking the potato does not eradicate.

Question.— What is your opinion of potatoes for seed that were blighted the previous year?

Mr. Fenner.— I should not care to plant potatoes that had been blighted, but if I did, I should select the best specimens — those most nearly typical of the variety.

Question.— What is the best commercial fertilizer for potatoes, and which is the best way to apply it?

Mr. Smith.— I don't know. It will all depend on the soil and cultivation. We can only give you some underlying principles to be governed by. One must watch the plant. Too much nitrogen will produce an overgrowth of stalk or straw. Potash will add strength to stalk and vine and color to fruit and foliage, while phosphoric acid perfects seed. As a rule, there is potash and nitrogen enough in the soil. What is most lacking is phosphoric acid. That must be present in sufficient quantity and be available for the use of the plant. By available is meant solubility in soil water. Unless there is present soil water, plant food is not available. Then, too, unless the South Carolina rock has been treated with sulphuric acid, it will not be available. I do not know how much acid is needed to reduce the crude rock, but it is a considerable quantity. On Long Island a formula is used consisting of 4 per cent. of nitrogen, 8 of potash and 10 of phosphoric acid. In commercial fertilizers, 1,000 pounds per acre, sometimes

2,000 pounds per acre were used. This is reinforced with barn manure. It did not pay to use of such a fertilizer more than 1,000 pounds per acre on potatoes.

Question.— How should potatoes be planted, in drills or squares to do the land the most good by cultivation?

A Farmer.— If I were going to give a general answer I should say, plant them in drills, providing I wanted the largest crop. But the check-row system will enable one to give better cultivation, which may be needed on weedy land.

Question.— Shall we plant shallow and hill up, or deeply and give level cultivation?

Several farmers said they preferred deep planting, followed by practically level cultivation, the cultivator doing all the hilling necessary.

Question.— Will it be most profitable for farmers to continue growing potatoes, or do mixed farming?

Mr. Ward.— On Long Island, potato growing has been extensively carried on a number of years. Thousands of dollars are annually expended for commercial fertilizers, the amount having been increased each year, until the farmers were putting on a ton to the acre. Experiments, however, showed that one-half as many fertilizers, if applied with barn manure, produced better results. This was because the manure added humus to the soil, which held moisture that made the plant food in the manure and fertilizer available.

Question.— I have a piece of land that has been fertilized with horse manure a number of years and is very rich. I plant potatoes on it every year. The tops grow very rank, but the tubers are very small. What shall I do to increase the size and number of tubers?

Mr. Smith.— There is too much nitrogen in the soil. Apply available potash and phosphoric acid. Muriate of potash and dissolved South Carolina rock are best. Potatoes require these mineral elements, particularly the potash. Wood ashes will be found a good fertilizer for potatoes on such soil, provided they do not cost too much.

Question.— How many potatoes, and how should they be cut to plant an acre?

Mr. Woodward.— It would depend on the size of the potato, the richness of the soil and the variety of the potato. Rural New Yorker will produce best when cut to one eye and planted in drills, 14 inches apart in the row. It will require from 12 to 14 bushels of whole seed for an acre of that variety.

Question.— What are Mr. Litchard's rules for growing potatoes?

Answer.— Potatoes are the best crop I grow. They pay more profit than any other crop with me, while they have steadily increased in price during the last 30 years; and yet I had rather take off three crops of corn from my soil than one of potatoes. But, to grow profitable crops of potatoes, three things are essential — seed, soil and sense. We use a clover sod, well fertilized, and good seed; then give proper cultivation, which is pretty nearly level. The cultivation should be thorough, and most of it should be done before the seed is put in. Do not allow the seed potato to sprout before planting. I cut mine and plant one piece in a hill, with one or more eyes on it. As a rule, too much seed is planted. It is not good policy to plant small potatoes. Plant normal-sized, cut properly, then keep the ground thoroughly stirred on the surface and kill off the bugs.

Question.— Is rye a good green crop to plow under for potatoes to follow? Have potato-growers been successful in using rye for that purpose?

A Farmer.—I plowed it under May 15th. The soil was a sandy gravel. The rye was sown the September before. I plowed it under six inches, planted potatoes and had a big crop.

Other farmers present said they had been successful in plowing under rye and following with potatoes.

Mr. Rice.— Rye will furnish a good deal of humus.

Mr. Goodrich.— I should be afraid that the rye would take too much moisture from the potatoes, especially in a dry season.

A Farmer.— Three-fourths of the farmers present are plowing under rye and following with potatoes. They cannot succeed with clover, and so grow rye, and are succeeding well.

Mr. Abbey.— I think that you make a mistake in allowing the rye to grow so high — some of you say four feet. I should not have it higher than 15 inches.

Mr. Smith.— Rye four feet high is too woody. If plowed under when it is a foot or 15 inches high, more humus will be furnished, because it will rot more quickly. Then, too, it will not draw so heavily from the moisture supply in the soil, as will rye allowed to grow to such a height. It requires from 300 to 400 pounds of water to perfect a pound of dried weed, so it is seen that, to grow rye, or any other crop, the soil must have moisture, if the plant is to be perfect and matured.

Question.— Is any benefit derived from hilling potatoes?

Mr. Chapman favored slightly hilling them, or rather planting them deep enough so that the tuber will be under the surface. The cultivator will hill them enough. The shovel plow and hoe cut off the roots and thus lessen the crop.

Question.— What are the benefits in the use of a weeder in potatoes and for covering grass seed?

Mr. Smith.— The thorough preparation of the soil is of great value; but it won't make good land out of poor land. The first need is good physical condition; this is brought about by incorporating humus into the soil. This done, use the cultivator and weeder to fine the soil and bring up the moisture and to prevent it from escaping by evaporation. It will then be held by the vegetable matter, and thus make plant food available. Prof. Roberts grew crop after crop of potatoes on the same field without any fertilizer, in this way, the soil having first been thoroughly supplied with humus.

SHEEP.

Question.— I have 20 lambs; expect about as many more. How shall I get them through to grass on timothy hay?

Mr. Woodward.— The cheapest way will be to kill them and throw them out. That man has a hard job. If I were in his place, however, I should feed them some potatoes and mix with them some wheat bran and oil meal; with those he may be able to carry them through on timothy hay till time to turn out to pasture. There is no hay so poor for lamb feeding as is timothy. I should much rather have Canada thistles, cut green and well cured. Timothy, as usually cut and cured, is no better than so much brush.

Question.— Our sheep are troubled with colic, blindness and death; what are the causes and remedies?

Mr. Woodward.— Probably they are fed timothy hay or other like dry foods. Sheep will not thrive or live long when so fed. They should have either silage or roots, or both, with the dry foods. But timothy hay should not be fed at all. Feed good, early cut clover instead. With that, ensilage, wheat bran, some oil meal or ground oats, if the sheep are well housed or otherwise cared for, they will not have colic.

Question.— How much room does Mr. Woodward allow his sheep in the barn?

Answer.— We put 20 ewes in a pen 18 feet square. It gives them room enough.

Question.— Don't you allow your sheep to go out for exercise?

Answer.— No. Who ever saw an old sheep take exercise?

Several Voices.— I have. Your sheep are not brought up as ours are.

Mr. Woodward.— If sheep are fed unbalanced rations, such as dry, fattening foods, they must go out and get exercise. They must have something to burn up the undigested food in them. But, when the sheep are kept in a barn and are fed warm silage, or turnips and clover hay with wheat bran, they will require no exercise.

Question.— How about beans for sheep?

Mr. Woodward.— Beans and bean fodder are all right in a limited quantity for store sheep. Feed a few potatoes in connection with the other foods. If, however, you feed too many beans the sheep will die. I have killed a number that way. They all died from burst bladders. I don't know how it occurs; have asked a number of medical experts, but they all replied that they did not know. There is something in the bean, when fed too largely to sheep, that influences their kidneys and bladders to such an extent as to cause death. Another point: If sheep are to be put in a barn they must have all the absolutely pure water they will drink. They will not drink dirty or impure water, nor eat food that you have placed your foot on. I have tried it and seen the sheep eat all around that part of it, leaving it untouched.

Question.— Which will pay best, wool or mutton?

Mr. Woodward.— Forty years ago the farmers kept sheep for their wool alone. It was profitable then, but is not now; but, some sheep may be profitably kept on most farms if meat is made the predominating factor. Winter lambs are most profitable to grow, but to be successful the sheep should be properly kept and fed. Make the sheep barns dry, warm, light and well ventilated; put the sheep into them early, before cold weather sets in, and feed them corn silage, clover hay, wheat bran, some linseed meal and turnips. Sheep are weed destroyers and will eat off almost every weed as fast as it springs up; so they are valuable on a bushy, weedy farm. They are also valuable to put in an orchard. Put in twice as many as the land will support; then feed enough bran to support them. Three cents' worth of bran will keep a sheep pastured in an orchard one week. Sheep will eat every wormy apple that falls before the worm has time to crawl out of the hole. Give me a flock of sheep to put in an orchard a mile away from any other, and in two years I will guarantee there will not be a codling moth or wormy apple in it.

Question.— What breeds of sheep do you prefer?

Mr. Woodward.— The old American Merino; but that is no evidence that they are best for you.

Question.—What is the value of ensilage, compared with clover, for feeding sheep?

Mr. Smith.—A man will want clover hay to go with the ensilage. He wants them both. Clover furnishes the protein, ensilage the sugar and starch, both of which the sheep require.

Question.— What causes lambs to become stiff at the age of four to six weeks? What is the remedy?

Dr. Smead.— It is a rheumatic trouble. As a rule, the slim lamb does not have the disease. We find it is one whose mother is a deep milker, and so the lamb takes too much of it. The ewe that does not furnish milk enough, forces her lamb to look elsewhere for food. Succulent foods are required. When I find such a diseased lamb, I assist it all I can by helping it to walk, and by rubbing it. The remedy is a half-teaspoonful of spirits of nitre.

Mr. Woodward.— If the breeding ewes have all the succulent foods they want, there will be no trouble with the lambs. We have never had a sick one from this disease.

Question.— What is a good ration for breeding ewes?

Dr. Smead.— With mixed clover and timothy hay for rough feed, the grain should be rich in protein. Wheat bran with oats and peas makes a good ration, giving about one-fourth of a pound to a hundred pounds of sheep. When timothy hay and corn fodder is the roughage, the grain ration should be doubled.

Question.— What am I to do to kill the ticks on my sheep in winter?

A Farmer.— Sheep dips will kill the ticks; so will washing the sheep. If I did not want to shear my sheep early, I should use the dips. If I wanted to shear them early, I should wash them.

Dr. Smead.— It is a shame for any man to have ticks on his sheep. I "got out of the woods" long ago, and know that ticks could have become extinct long ago had the farmers been thorough in their work. Get some one of the various dips on the market. They are all good; but I should advise selecting some one of the carbolic dips. When dipping the sheep, allow its head to go under.

Question.— But what shall we do in winter, when there are not only ticks but some of those little red-headed lice on the sheep, which terribly annoy the ewe about to drop her lamb in a few weeks?

Dr. Smead.— I have a way of doing it. Turn the sheep on its back, and, from an old coffee pot, pour a little stream of carbolic dip all along the belly, from the nose to the hind legs. Pour on about a quart. It will go right down to the skin and completely around the body, leaving the wool almost wholly dry. The lice do not eat, but suck, and the carbolic dip stops the breathing holes in their bodies, and thus kills them, and also kills the ticks which have gone close to the body for warmth.

Question.— Will Dr. Smead tell us where the profit is in sheep?

Dr. Smead.— There is as much profit in sheep when properly handled and cared for in western New York as in the dairy; but a man must have a love for the sheep and know how to feed and care for them, and must select the best breeds, just as he should select the best dairy cows. The dairy cow has a dairy form; so has the dairy sheep. Select it. As many as eight fine lambs have been reared from five ewes, in flocks in our town (Logan), and a revenue of $5.50 for lambs and $1.20 for wool per sheep derived. Such sheep will be in proportion of about five for one cow. The cost of keeping the five sheep and one cow will be just about the same, and there are many farmers more capable of caring for the sheep than for the cow.

Question.— Would you advise the feeding of bean fodder and silage at the same time to pregnant ewes and cows?

Dr. Smead.— I do not know that I can answer the question as fully for the cow as the sheep. But, in my own judgment, I should not feed more than four pounds of the bean pods to a ewe weighing 150 pounds. I should feed ensilage and the pods morning and night and mixed hay at noon. Sheep require a variety of foods.

Question.— Would you advise feeding the silage to ewes which are suckling lambs?

Dr. Smead.— Yes; if not too much is fed; but there should be some clover hay fed as well as some of the protein foods, and the process should begin before the lambs are dropped.

Question.— Are winter lambs profitable?

Mr. Woodward.— Yes; if conditions are favorable. We find it very profitable. This winter they have averaged $10 a head at 10 weeks old. Study the business carefully before you attempt it and start in a small way. The best feed is linseed meal, clover hay, oats and wheat bran. If corn is fed it should be cracked.

Question.— Is it safe to allow sheep to eat all the rape they will, if they are turned into a field of it?

Mr. Woodward.— No. If too much is eaten, bloat will ensue. Do not turn the sheep into the rape field till after the dew, or any rain that may have fallen, has dried out. When the rape is dry, turn them on; allow them to feed awhile, then turn them into pasture. It is well to have two fields; when one is fed down closely, turn the sheep into the other. It grows up again very soon, and will continue to grow till the ground freezes. The plant belongs to the cabbage family, and is one of the most valuable sheep and pig foods grown. Dwarf Essex is the best variety. There is another, known as the German rape, which is the one that produces canary bird seed. Do not make the mistake of sowing that. Sow the Dwarf Essex in drills 18 to 20 inches apart, or it may be sown broadcast. But in drills the ground may be cultivated awhile. If sown in drills, two pounds of seed is enough for an acre; if broadcast, four pounds will be required. For early feeding, sow about the time of corn planting. For late feeding, sow in July; and it is a very good plan to sow the seed in the corn at the last cultivation of the crop, say, in July.

Question.— Is the Horned-Dorset sheep proof against the attacks of dogs?

Mr. Woodward.— No; nor is any other breed that I know. The only advantage the Horned-Dorset has over any of the Down breeds is for winter lamb raising. For this purpose it is superior to all others.

Question.— Will Mr. Woodward tell how many sheep can be housed in a shed 16 by 60 feet? How would he arrange it?

Answer.— Sheep should have a cubic foot of air space to one pound of live sheep. We put 20 ewes in a pen 16 feet square and 9 feet high. But the pen must be kept dry, light and properly ventilated. You may easily estimate from these figures. I am speaking now of breeding ewes. Sheep that are being fattened may be somewhat more closely confined. But I should not put sheep into a shed unless it were boarded up and made warm, dry, light and comfortable. Of all the farm animals, sheep are least fitted by nature to withstand cold, storm and abuse. They must have good quarters, good and proper foods, and good care. Our sheep are all in the barns, and have been since November, and were shorn several weeks since. They will not go out until the weather is warm.

Question.— Does it pay to wash sheep? Is it good for the sheep?

Mr. Rogers.— I don't know whether it is good for them or not, but we wash them. Sometimes we have sick sheep after washing them. I know of no physical good to them, but we get more for the wool, nearly a third more, although we do not wash out a third in weight.

Mr. Van Dreser.— During the last 20 years we have not washed a sheep. Ours are Scotch Cheviots, and we get only three cents a pound less for unwashed than for washed wool. I do not believe that washing does them any good, and I know that it does not benefit the man who does it.

Question.— What does Mr. Woodward feed 15 sheep on an acre beside the three cents worth of bran?

Mr. Woodward.—Just what they can pick off the ground. Three cents worth a week will keep them, but we buy our bran in the summer for about $10 per ton. The sheep also eat all the weeds and windfall apples and will not gnaw the trees or limbs.

Question.— Where do you buy bran at the prices you name?

Answer.— In Buffalo or in Lockport. There is about $2 difference between the price of winter wheat and spring wheat bran, but the spring wheat is just as good as winter wheat for sheep feeding.

Question.— Will silage, if fed to young lambs, injure them?

Mr. Witter.— No, sir; we had 110 lambs last year. Did not lose more than 10. They had some silage every day. I have grown lambs to 50 pounds at the age of 60 days, that were perfectly healthy. They got some silage every day, but we did not feed it but once a day and then in limited quantities. So fed, it is an excellent food for lambs. Our lambs begin to come about April 1st. We do not grow any hot-house lambs.

Mr. Smith.— Mr. Woodward of Lockport has 600 winter lambs. They are fed some ensilage with clover hay, wheat bran and oil meal, daily.

Question.— What breed of sheep is the most profitable for the farmer of to-day?

Mr. Smith.— There are a number of sheep breeders here; give us your opinions. No response. A vote, however, showed that the Shropshire was the favorite.

Mr. Woodward.— It would all depend on what a man wanted to do with the sheep. If he is after winter lambs, the Dorset is the best; if for wool, some of the Downs are best, provided they are properly fed and cared for; for winter lambs to sell early, use the old American Merino for the dam and the Dorset for the sire; if one wants lambs to fatten and sell at the age of one year, use the American Merino for the dam and some one of the Downs for the sire. If you want to keep any of the pure English breeds, you must arrange to give them much better care than you do any of the American breeds. A Hampshire sire and American Merino will doubtless give the best results for fattening lambs.

Question.— What is the value of timothy hay for feeding to sheep?

Mr. Woodward.— None at all. I will not allow a man to sow a pint of timothy seed on my farm. I had much rather have Canada thistles, if cut early and well cured. I have tried it time and again and failed every time with timothy.

Question.— Would you feed silage to store sheep?

Mr. Woodward.— Yes. We once fed a pen of old ewes all they would eat; they came out the best ewes we had. The same was true of our winter lambs, they did as well as when on any other foods. We feed about four pounds of silage to each 100 pounds of sheep. I also grow turnips to feed to sheep, because I want as much succulent food as possible, as well as a variety of such foods. It will pay to grow turnips, leave them in the ground and plow them under in the spring.

Question.— Is millet a good hay for sheep?

Mr. Ward.— No. And I have fed it every day this winter. There is no crop that varies so much in quality as does millet; but, if it is cut before it begins to show signs of seeding, it does very well, especially for horses. For sheep, however, it is not as good as is silage, alfalfa, clover, rape, and some other like foods.

Question.— Are beets injurious to sheep?

Mr. Van Alstyne.— I have kept sheep all my life, feeding them beets and turnips, and have found that the sheep did much better when fed on succulent foods, such as turnips and beets. Silage is also good for sheep, but I think I cannot afford to feed silage to them when I have roots.

Question.— What is the best grain for fattening sheep?

Dr. Smead.— If I could have an ideal feed, I should have a field of rape in the fall. Sow it in the corn; also some peas. When the corn is off, you will have an ideal pasture. Turnips are also good. Use the Dwarf Essex rape, sowing about two and a half to three quarts of seed per acre. With those foods, give some wheat bran for lambs; for fattening sheep, add corn meal. It will pay every time to add some wheat bran and oats to the lamb's rations. Rape may be sown as late as the 1st of August and cultivated in among the corn rows. It is not a good cow food, because it will taint the milk.

Question.— In feeding sheep, why not feed whole buckwheat?

Dr. Smead.— Because the middlings contain nearly three times as much protein as do whole buckwheat. When the flour is taken out, all the starch and sugar go, leaving only the protein. In buckwheat "hulls" there is only about one pound of protein in 100 pounds of the hulls.

Question.— What is the best grain for fattening lambs?

A Farmer.— Clear oats and clover hay.

Mr. Smith.— I heard Mr. Woodward say that a small ration of silage, clover hay, wheat bran and linseed meal, is the best for lambs. Later in the season some corn is added, especially if the silage is a little deficient in the grain part. The main object is to get the most and quickest growth of lamb for the money expended; but there must be some succulent food, such as silage or roots, with the grain, else the lamb's stomach gets out of order.

Question.— What per cent. of bran would you mix with corn for fattening lambs that are being fed on straw and bean fodder?

A Farmer.— I have always used a good scoop shovelful of bran to a bag of cornmeal.

Question.— Why is it not better to give sheep exercise in winter?

Mr. Woodward.— They get all the exercise they want in the pen. No one ever saw a mature sheep stirring about for exercise. But I saw some up in this locality, skirmishing around the barnyards and on the bare meadows, in search of something to eat. It was hunger, not exercise, that made them do it. Young lambs, however, take exercise in play, but old sheep do not.

Question.— How can I make a sheep own her lamb?

Dr. Smead.— Sometimes the mother has not sufficient nourishment for the lamb. I should take the ewe away from the other sheep, put the lamb with her, and feed her so she can make plenty of milk for it.

MISCELLANEOUS.

Question.— Do you advise farmers to organize into associations for self-protection against sharpers?

Dr. Smead.— If you have not a grange here, by all means organize one. There is no organization that I know so beneficial to the farmer. Whenever we go to a town where there is a grange or some other like organization, we see the ladies coming in, and find a higher order of intelligence than elsewhere. Every farmer ought to belong to the Grange. Every other branch of industry has an organization, then why not the farmers, and I know nothing better than the Grange.

Mr. Stevens.— The grand old State of New York leads all others in granges, having more than 62,000 members.

Question.— What will " kill out " horseradish?

Mr. Lillie.— The only way to kill all obnoxious weeds is by cultivation. Do not allow the plant to breathe; cut it off every time you see it above ground.

A Farmer.— Will we have to sit up nights to do it?

Mr. Lillie.— No, if you will work during the daytime.

Question.— How can we best dispose of quack grass?

Mr. Smith.— Mr. Cook of Denmark, kills out quack grass on his ground by plowing, then following with the cutaway harrow till the ground is well fined. Then a sown crop is put on. After that is taken off, winter wheat is sown, which smothers out the quack.

Question.— To what extent would good roads benefit the farmers of Niagara county?

Mr. Rice.— That is a question for you farmers to decide.

A Farmer.— It is a question of vital importance to the farmers here who have to haul so much fruit and cabbage to market, or to the railroad, and the farmers should take into consideration these points. The time saved in this transportation and the greater amount they can draw, will soon more than pay their share of the cost. Good roads will also benefit our cities and villages, which, as a rule, are in favor of having better roads, and willing to pay their share of the cost.

Mr. Rice.— A few years ago the good-roads question was much discussed in some parts of New Jersey, but the farmers opposed it. Notwithstanding all that, many miles have been built, and now the farmers are tumbling over one another to have more of them— they having found that they can haul enough larger loads and make more trips, to more than warrant the expense. I am in favor of good roads, and am of opinion that sooner or later, we are going to have them all over this State. Westchester county has appropriated money enough to build two lines of roads each 12 miles long. Yet we have farmers living on parallel roads a short distance away who are opposing the move. Some farmers living on these proposed new roads are also opposing the move, but the new roads will surely come, and, next year, we will have more miles of them built.

Question.— What can we do to destroy the cabbage worm?

A Farmer.— Feed them Paris green.

Mr. Gould.— A little freshly slaked lime will raise a blister on a cabbage worm's back and cause him to emigrate very quickly. The same antidote will kill a potato bug. Put it on in solution.

Question.— What will eradicate wild lettuce?

Mr. Rice.— I don't know; I have never seen it, so am not familiar with it. My advice is that you send for Prof. Lowe. He has a large number of charts showing many species of weeds, both in blossom and ripened, so that the seeds, blossoms and stalks may be seen. No doubt he will come and give you an illustrated lecture, and may be able to tell you all about this lettuce as well as some other noxious weeds which you may have.

Question.— Can ordinary people distinguish oleomargarine from butter by eating, or otherwise?

Dr. Smead.— Oleo takes the place of butter in some places, and is sold as butter, but not in this State, as our laws prevent the fraud. It will not keep, and it is difficult to distinguish it from butter by its taste; but, if you will rub a little of it on your hand, you will readily distinguish it from butter. Then, too, butter digests in the stomach's temperature, while oleomargarine requires 102 degrees to digest it.

Question.— What is the value of the plant food in 20 bushels of beans or 150 bushels of potatoes per acre?

Mr. Smith.— When 20 bushels of beans are taken off an acre of land, plant food to the value of $8.64 goes with them. If 150 bushels of potatoes are taken off $5.30 worth of fertility goes with them.

Question.— Do you advise using salt to any extent on any or all crops of grain, and what do you think of sowing flax with grain that is handled unbound?

Mr. Rice.— I do not know anything about flax. I saw it growing in a small way at Cornell, and remember that it requires rich land, as it is a rampant feeder. I do not believe one can afford to buy too much salt. It releases plant food and conserves moisture to some extent, but there is no fertility in it.

Question.— Is fall plowing a good thing?

Mr. Smith.— It is said that naked ground is poor ground. It is much better to have some crop like rye on it, to plow under in the spring. If, however, you have very heavy land, which cannot be worked earlier in the spring, it is well to plow it in the fall. But if the land is gravelly, no man can afford to plow it in the fall. Put on some crop to turn under in the spring, to add humus. You may put a ton of the best fertilizer you can get on an acre, but if the other conditions are not right you will get no benefit because there will be nothing present in the soil to make it available.

Question.— What can be done to prevent fall-sown rye winter killing?

Mr. Woodward.— If you will put five good loads of manure on to an acre, after you have plowed it, and harrow it in, then sow the rye, it will not winter kill. Our clover seed sown in the spring always makes a good catch. I cannot remember when we lost a clover crop, but the seed should be sown early. Harrow the manure in to a depth of at least two inches.

Question.— Do red kidney beans impoverish the soil?

Mr. Smith.— I do not know that they take any more fertility from the soil than do other varieties of beans. But, to get good crops of beans of any variety, the land must be well fertilized.

Question.— Will it pay to subsoil clay lands? How near does it come to underdraining?

Mr. Woodward.— Underdraining would be very much the best. If your ground is heavy and subsoiled only, the water will go into it, and, when evaporated out, will leave the soil just as hard as before. The only remedy is the underdrain for such land.

Question.— How can one pair of hands do the work of two women?

Mr. Woodward.— Get the old gentleman to help her.

Mr. Rice.— It is a lamentable fact to-day that the farmer's wife is called upon to do too much; but it seems to be unavoidable. I know of no other way, except to build tenant-houses; then employ young married help; have them live in these houses and board themselves. We are adopting that plan; have one or two tenant-houses, but just as soon as we can spare the money we are going to build more. Much work might be saved if the kitchen, pantry, range and water supply were properly arranged. In many farmhouses it is nothing but trot, trot, trot, for the farmer's wife from morning to night. Make the kitchen conveniences better and some of the daily drudgery will be taken off the shoulders of the tired, worn-out farm wife.

Question.— Would it be practical to advise a windmill or any other force power for raising a water supply for bathtub and other house purposes, when the eaves of the house can be run into a tank in the garret, to do the same work for $14, and be practical for every farmer?

Mr. Woodward.— There is no power so cheap for pumping water as a windmill. I have several, some of them having been in use a number of years, and have not cost me 15 cents a year for repairs. I had much rather have the wind turning my windmill and pumping water than to have it blowing over my head while I work the pump handle. I don't know about the cost of the tank in the garret, nor the expense of piping water from the eaves into it.

Question.— Give your method of disposing of burdocks, especially those of our neighbors, that grow along the line fences?

Mr. Rice.— I can control the burdocks on my farm by cutting them when the stalks are hollow and applying a little salt or kerosene oil. But when it comes to my neighbor's burdocks I draw the line.

Question.— What would you do to destroy wire worms?

Mr. Smith.— Cultivate. The man who follows a short rotation will not have wire worms. If they are in sod, plow it in the fall. Timothy sod is their home.

Question.— Can seed corn be so treated as to prevent crows from pulling it?

Mr. Woodward.— Soak a few quarts of corn and scatter it along the edge of the field. The crows will feed on it and leave the planted corn untouched. They never eat a dry kernel, but wait until it has become moist and swollen.

Mr. Smith.— You will find the crow one of the best friends, all things considered, to the farm. It will destroy insects and save more crops than it will destroy.

Question.— Give a good crop for the ordinary farm of mixed soil with gravelly loam predominating.

A Farmer.— Potatoes after clover or timothy; next, some grain crop one year, then seed two years, making a five years' rotation.

Question.— Why do so many of our forest trees die, especially the maple?

Mr. Witter.— Probably it is caused by the borer, or the forest worm caterpillar. I know no remedy.

Question.— Where the soil is a clay mixture and gets rather hard, do you recommend the sowing of oats without plowing the land?

Mr. Gould.— No, sir. The only thing to do with such a piece of ground is to put in a plow and turn it upside down; then fit it well before putting in the seed.

Question.— What is the best and cheapest way to renovate a worn-out or run-down farm?

Mr. Witter.— No doubt you have farms which have been kept up by keeping up the supply of humus in the soil. This vegetable matter must be supplied in order that moisture may be held. That is the first necessity. The original soil had this humus. Long-continued cultivation and the neglect to replace the humus have caused the land to become "run down." Barn manure, when all is saved and applied, or the turning under of green crops, will furnish this humus. The clovers are the best for that purpose. Rye is also sown for that purpose, but it must be plowed under before it becomes hard and woody. It takes about 340 pounds of moisture to perfect one pound of weed, and nearly 500 pounds of water to perfect one pound of oat straw and grain, so it is readily seen how important it is to secure and hold moisture. If rye is allowed to grow too large, it will be readily seen that it will take moisture, which cannot be restored that season. I prefer clover for plowing under, for the purpose of restoring humus.

Question.— Mention the cheapest and best way to get rid of cedar stumps.

No one present could answer the question fully. Mr. Goodrich said that he and others had just bought 24,000 acres of land, covered with stumps, and he wanted to get information. No one could give it, however.

Question.— Is there any government bulletin for distribution to applicants?

Mr. Rice.— Write to the Department of Agriculture at Washington for their bulletins, which are free. You will get the information you ask. The Department also issues a volume known as the "Agricultural Record," containing much needed information; but it costs $1 a year.

Question.— Should we breed thoroughbred stock only?

Mr. Woodward.— That will all depend on the man. No scrub man ought to be entrusted with thoroughbred stock. Let the breeders handle that class. If you want a sire or dam, buy of the breeders. For myself, I much prefer a cross-bred lamb to a thoroughbred, and I think, all in all, good cross-bred cows as well as sheep are preferable for the farmer on the average farm and for the average care and food they get.

Question.— Does not cultivation take the place of rain? If so, why?

Mr. Rice.— No; it cannot do that wholly, but it is supposed that dry soil will absorb moisture at night, which escapes in the morning. But when the surface of the ground is made fine a few inches deep, it acts as a blanket, which prevents the moisture from escaping from the soil. We find this true when we turn over a plank, or something of that sort, in summer. When we do that we always find the ground moist. It was in such places that we looked for angle worms for fish bait. We never looked for them in a hot, dry soil. So that, thorough cultivation, in part, takes the place of rain. The man who keeps his cultivator going every day during a drouth, at a slight depth, gets a crop of corn, while the other man does not. By the other man I mean the one who does not cultivate, but, on the other hand, allows his land to bake.

Question.— Does the mulch caused by cultivation produce a chemical change in the soil, or merely take the place of a cover to protect it from the sun?

Mr. Rice.— Cultivation does not change the chemical character of the soil, except that it liberates plant food. The mulch is most valuable to induce capillary attraction, that is, for pumping moisture from a depth below the surface, and preventing it from escapting by evaporation. To illustrate: Rake over a piece of ground in the garden, and make the surface very fine but shallow. Do it at sunset, after dark; allow a cat to walk across it. In the morning every one of her tracks will be moist, showing that, by the compacting of the surface by the cat's feet, the moisture had a chance to come up and get away.

Question.— I have a drilled well, furnishing an abundance of water. Shall I erect a storage tank and windmill or pump it from a spring 80 rods away?

Mr. Woodward.— Build a storage tank, put up a windmill and pump the water directly from the well. I have two windmills, one in use 15 years. It furnishes water for the barn and house, and costs but little. I do not see how any farmer who can have such a device, can get along without a windmill. Its cost, like some men's religion, is not more than 15 cents per year.

Question.— How would you prevent the appearance of weevil in beans?

Mr. Smith.— Use bi-sulphide of carbon. Get a 25-cent bottle of it. Put some on a sponge and place it in the mouth of the bag, barrel or bin and cover tightly. It throws off a gas that is heavier than the atmosphere, and so sinks. It will go all through the package and kill all insects or other life therein. But it is highly explosive, so do not go near it with fire or inhale it.

Question.— How shall we know when our soil needs fertility, and what to apply?

Mr. Smith.— Interview it; use your eyes; ask the crops; watch it and study it. If the grain falls down, it shows that there is too much nitrogen in the soil; if it makes a puny, feeble growth, there is not enough. If the plant lacks strength and color, potash is wanted. If the grain does not "fill" or the seed mature, phosphoric acid is required.

Question.— Does sorrel indicate a sour soil?

Dr. Smead.— No; I have a field on which sorrel grows. I tested it with blue litmus paper, but found no acid. On the other hand, I found it on land I little thought contained it.

Mr. Smith.— Sorrel does not always indicate an acid state of the soil, but poverty instead.

Question.— Is the Grange of any financial benefit to the farmer?

Mr. Smith.— It may be in some instances, but no man ought to join a Grange for the money he can get out of it. He should join it for the purpose of uplifting himself and family socially, and bringing him more closely, socially, with his neighbor. Wherever we come in contact with a live Grange in a town where an institute is held, we find a good attendance. The ladies and children are all there, and there is a program of music and other local attractions.

Question.— Is the Babcock machine a fair one to determine the value of milk for cheese?

Mr. Smith.— Yes. There are hundreds of factories in this State and in Wisconsin where milk has been paid for on the basis of its butter fat during the past six years. It shows fully just what the milk is worth, not only for butter, but for cheese. Dividends are declared on its verdict week after week, and all patrons are satisfied. There is a factory at Belleville, Jefferson county, which has 70 patrons with nearly 1,300 cows, where the Babcock has been in force five years; and another at Vernon, where it has been in force six years. At neither of these factories can the machine be driven out. There is no longer any question about the fairness of the test for all concerned. It offers a premium on good milk; the old pooling system, a premium on poor milk. Where the Babcock is in force, every patron is striving to produce a higher quality of milk because he is going to be paid for it. Where it is pooled there is no such effort; all the patrons care is to be sure their milk has 3 per cent. of butter fat in it, with the other solids in proportion.

Question.— How may one tell if there is acid in the soil, and how to correct it?

Mr. Smith.— By the use of what is known as litmus paper. There is the blue, which determines whether the soil is acid or not; a slip of it buried in the soil a few minutes, if the soil is acid, will change to a dull brick red; the red variety, if the soil is alkaline, will change from the red to the blue color.

Question.— What shall we do for a sour soil?

Mr. Smith.— An application of lime will correct it.

Question.— Should there be any acid in the soil?

Mr. Smith.— I do not think there should be. Clover will not grow on such soils, nor will many other crops. The germ that causes any of the legumes to gather nitrogen from the atmosphere, store it in nodules on their roots, to be given to the soil, will not live in an acid soil.

Question.— What make of cream separator do you think the best?

Mr. Smith.— We can't recommend any one. If we did, every other manufacturer would be after us and make our lives unbearable. There are a number of them, all which are good and will skim all the cream out of the milk. But, when one becomes used to any one pattern, he should not change it for another.

Question.— Is the aquatic separator as good as the other kinds?

Mr. Smith.— No. Nor is it a separator at all, but a device for raising cream through the dilution of milk with water.

Mr. Gould.— Why should a man buy an $8 double tin can under the name of separator, when he can buy it under its proper name, and just as good for $3?

Question.— Which cow tie do you consider the best, the chain or bow?

A Farmer.— The bow tie.

Mr. Woodward.— That is the Newton tie. But the best place for a cow in the stable is the Bidwell stall, which is a small box stall, in which the cow is loose. But it is too expensive. Our arrangements are simple. There are two poles, reaching from the floor to the ceiling, and one in the rear. The cow is tied with a chain around the neck to one of these uprights; the next cow to the upright opposite. This prevents the cows quarreling, or stealing from one another, while both can drink from the same basin. The fastener is known as the Ohio patent, and costs about 20 cents each. We think the arrangement the best of any we have yet seen. The only trouble with the Bidwell stall is, that it almost completely hides the cow, so that, if you want to show her she must be taken out.

Question.— What about the swinging stanchion?

Mr. Smith.— It is a very good one; an improvement on the old rigid stanchion, as it allows the cows more freedom; but it is not as good as those mentioned.

Question.— Do you get all the cream when using the water separator? How does it compare with other methods?

Mr. Gould.— It is a fact that it will skim milk from cows long in lactation more closely than will some other devices, which is not saying much for it.

Question.— I have a small farm. How can I get the most money from it?

Mr. Smith.— That depends; if a man were near a city, possibly he would get most from small fruits or milk, according as he had a market.

To Mr. Gould.— What is the best device for fastening cows in the stable?

Answer.— I have about concluded that the best way is to cut off the cows' horns, then put five cows in a box stall. A chain around the neck snapped into a rope, and fastened to a swing stanchion, is a good fastener. I do not know just which method I prefer. The chain will prevent the cow from stepping back and into the gutter.

Mr. Smith described the fixtures used at the Geneva Station stable, which was a chain around the cow's neck, snapped into a ring which slipped on a bar in front of the cows. It is preferred to the old way of having the ring slip up and down on a perpendicular rod.

Question.— Would it be proper for the State to send out speakers who are not successful farmers?

A Farmer.— I do not think we would care to listen to them.

Mr. Cook.— That is an old question. I have not heard it in five years.

Question.— What do you think about fall plowing?

Mr. Cook.— I think it folly to leave some of our ground unplowed till spring. As a rule, however, unless we can have some cover crop on the ground, especially when we do not have much snow, it were better to have it unplowed, to prevent the loss of fertility. There will be some loss of nitrogen, in the form of nitrate, from all freshly fall-plowed uncovered land.

Question.— Would you roll the furrow down as soon as plowed?

Mr. Cook.— Not necessarily; but I should roll it thoroughly before harrowing it, to compact the ground so as to prevent the loss of moisture through evaporation.

Mr. Chapman.— As a rule, nearly 20 per cent. of our crops are lost for a lack of water, while 50 per cent. of the rainfall runs away. Now, if the soil is plowed in the fall it will hold a portion of that water which, if the ground were not plowed till spring, would be lost. We cannot grow crops unless we have moisture. If we secure it for the use of the plant we must store it in the soil, and it can be best done by plowing the land in the fall. Another point; the lumps are better pulverized because of the action of the frost, thus preventing the loss of water which would come if the lumps were large. Another point; one can get on to a piece of land and harrow it earlier than he could plow it. If the ground is so prepared and the surface is fine, very early in the spring, the fine mulch on the surface prevents the loss of moisture through evaporation. Still another reason for fall plowing is, that it can be done more easily and more cheaply, from the fact that one has more time in the fall than spring, he being not so crowded. There can be no loss of fertility in fall-plowed land, unless some of the nitrogen is changed into a nitrate.

A Farmer.— How shall we get rid of hawkweeds?

Mr. Richardson.— A rotation of crops or cultivation, if one can plow the land, will kill out the hawkweed or almost all other weeds. Although if you get it out it will come again, because there are so many waste places where the seed lodges and thus secures a permanent foothold.

Question.— Is the weeder a desirable tool?

Mr. Chapman.— I consider it very valuable. It saves much time in cultivating and hoeing. I use it in strawberries, corn and potatoes. It must be used in season, before the weeds start or the ground has become hardened.

Mr. Smith.— It can be used on beans, if at the right time. Use it once before the crop is up.

To Mr. Richardson.— What is the best and most practical way of fastening a cow when kept in the stables nearly all winter?

Answer.— I have had considerable experience in that line, and I believe the time has come to let the stanchions go. Such treatment as the confinement of a cow in a rigid stanchion, 12 or 15 hours, would not suit any of us here, and we know the cow has considerable human nature. Knowing this, I had one row of the stanchions taken out of my stables and replaced with the Knapp cow tie. Later, we took out all the stanchions but three. Now every cow smiles when I go into the stables. Beside being more comfortable, she is able to turn and lick herself, and is also able to eat all there is in her manger. Having her stall all to herself, she cannot be injured by another cow, while she will be kept fully as clean as those in the stanchions. Then, too, she cannot reach through and steal a part of another cow's ration. But I am sorry to say that I still have to take the tie off and allow the cows to go out and drink. I have, as yet, no inside watering device. But I ought to qualify some of my statements by saying that more room — that is, a wider manger in front of the cow, is required when the Knapp tie is used.

Question.— Realizing that intensive farming is the only one that pays, I should like to have you tell me to what degree can it profitably be carried?

Mr. Smith.— Ask the man how he is situated. What would pay one man will not pay another. If a man has confined himself to one branch of farming, he will, if he begins intensive farming, have to begin slowly. By this, I mean if a man has been growing grain or fruit exclusively, and wishes to enlarge, he will have to learn something that will enable him to work successfully. If a man has a dairy and has been practicing the timothy hay and corn meal system, if he changes, as he will be forced to do, he will have to study other methods. The time is near at hand when the dairyman will have to fill a summer silo to tide his herd over the drouth.

Question.— Is there any scientific proof that the planting or sowing of seeds in certain phases of the moon has any effect on the crop?

Dr. Smead.— I have never visited the moon, so I don't know; but I have heard it said that the moon has an influence on seeds. Yet all scientific investigation shows it to be a fallacy. Then, too, I find that these moon theorists do not agree. One says the new, another, the old, of the moon. There is more moonshine than anything else in the theory.

Mr. Chapman.— I once heard an old darkey say that he knew that watermelons would go very much further in the full, than in the new, of the moon.

Question.— How much better is a separator than a creamer, and what kind of separator would you recommend?

Mr. Richardson.— The first part of that question is easier to answer than the latter. There is no comparison between the two systems. The separator takes all but a trace of the fat out of the milk. The creamer will not. There are a number of good separators now in the market. All do excellent work.

Question.— Is there not a great loss of plant food by leaching from fall plowing?

Mr. Chapman.— There are but three elements of plant food which we care anything about. These are nitrogen, potash and phosphoric acid. The last two cannot get away unless they are washed out of the soil. The first mentioned must be changed into a nitrate, which will not evaporate unless the soil reaches a temperature of 70 degrees. So there can be no loss from that source.

Question.— Which is the cheaper — to bring water from a spring 120 rods away, or put up a windmill and tank?

Mr. Woodward.— That would mean buying 120 rods of pipe. I should put up the windmill and tank. I have a mill that has been in use for 13 years, and it has not cost me 15 cents a year for repairs.

A Farmer.— Why not use a gasoline engine, instead of a windmill?

Mr. Woodward.— It would require some one to start and stop the engine, and there would be some expense for gasoline. There is nothing so cheap as wind for motive power.

Question.— If you have a piece of sod ground in which to plant corn, will it pay to plow it and sow rye, the fall before, and then plow it under in the spring for the corn crop?

Mr. Woodward.— I should much prefer to have the grass on the ground. We allow it to grow all it will in the spring, never plowing the land till we are ready to plant the corn. Sometimes we have to put a chain on the plow, to get the grass all under. We then roll down the furrows hard, after which we fine the soil perfectly. This grass turned under will make humus to hold moisture, which the corn must have to mature it.

Question.— Is it advisable to continue the cultivation of crops during dry weather, after the ground has been thoroughly pulverized, even though the ground is dried as deeply as the cultivator has gone?

Mr. Smith.— The question evidently implies that cultivation has been deep; on the contrary it should have been shallow. But, if your soil is so coarse that the particles will not come together so as to form a dust mulch and prevent the escape of moisture, cultivation will not amount to anything. Shallow cultivation, if it is fine, pumps up the moisture and prevents its escape by evaporation. This is known as capillary attraction.

Question.— Are Angora goats a coming substitute for sheep for all practical purposes?

Mr. Woodward.— People have not yet learned to eat goat meat in this country; but I hear that young Angora kids are being dressed and sold as lambs. They will not pay here, but, in Pennsylvania, where the land is very rocky and hilly, it is said they are superior to sheep.

Question.— Would it be better to plow under some green crop, this summer, or leave the ground fallow, and cultivate, to prepare the soil for seeding, next spring?

Mr. Smith.— I should want some crops growing, to plow under, to supply vegetable matter. The putting on of plant food alone does not make land productive, unless it can be made available. This cannot be done unless the physical condition of the soil is right. Humus *must* be there, and moisture conserved, else all the fertilizer applied will be of no avail. By all means, have some green crop to plow under that will supply not only fertility but humus. Cow peas make one of the best crops for this purpose. Sow them in the spring; plow them under in the fall. Sow rye, and plow that under in the spring. Sow the cow peas when you would plant beans — after all danger of spring frost has passed. " Whippoorwill " and " Clay " are the best two varieties. Sow a bushel of seed, broadcast, to the acre, and harrow it in. It will furnish nitrogen, and with the rye give a good supply of humus. I have seen the experiment tried in New Jersey, where rye would not grow. The land would not grow moss, even. A Jew colony got hold of the land, and made a success of it. They changed a yellow, inert, barren sand to a black, productive one, on which grow good crops of clover. It cost $50 an acre to grub out the dwarf and scrub trees, and two years of labor before the results were reached. There was plant food there, but no humus. When, by plowing under cow peas and rye, the humus was supplied to hold moisture, the unavailable plant food was unlocked and made available for the use of the plant.

Question.— Which is best as an absorbent in a stable, plaster or South Carolina rock? Will either injure the manure?

Mr. Smith.— Plaster contains no fertility, but, on some soils it has some benefits of minor importance. It costs too much, however. It is better to use South Carolina rock, instead of plaster. By this, I mean dissolved rock.

Question.— Which will give best results, shallow or deep cultivation?

Mr. Rice.— Cultivate deeply at first, subsequently at a shallow depth, using a fine spiked-tooth cultivator, having a number of teeth. This breaks up the earth crust finely, makes a dust blanket of it, and thus prevents loss of moisture by evaporation. Such cultivation does not disturb the roots of the plants, which deep cultivation does. We also use the weeder, our aim being to kill the weeds before they germinate.

Question.— What is the cause of club-foot cabbage?

Prof. Harding.— That question comes up at nearly every institute. It is out of my field, but I can say that the cause is a fungus in the soil. The best preventive is not to plant cabbage on land where club-foot cabbage grew the year before. Lime, it is said, if applied to the soil, will make the conditions more unfavorable to the spread of the fungus.

Mr. Smith.— I do not know enough about cabbage culture to add anything to the professor's reply; but I think that the cabbage growers in central New York prefer old ground to sod, for cabbage culture.

Question.— Is the English sparrow a friend to the farmer?

Mr. Gould.— I do not know that he is a friend to any one. But I do know that he is an enemy to all other birds, and a thief. Then, too, he is an awful nuisance about the house, and we make it a point to get rid of him. We scatter a little millet seed in a furrow, and, when the sparrows gather on it, we pull a double-barrel shotgun on them. This gives us a week's cat rations and disposes of sparrows for a month.

Question.— Would you advise a young man to go to some other State, with the intention of raising lambs?

Mr. Witter.— I don't know; I visited 13 States of the Union last fall, and came back with the conviction that the old Empire State was as good as any of them. There is as good and as poor land in it as in any other, and the markets are as good. It would all depend on the man and where he was located. I should not care to advise such a man. He might succeed or fail, and I should not want to be responsible in any way, either for his success or failure.

Question.— How badly does a good crop of corn exhaust the soil, as compared with other crops?

Mr. Van Wagenen.— There is no crop that will give us as much for the cost as will corn, for a starch food. But it is an enormous feeder and must have plant food, light and heat; but it does not take as much plant food from the soil as do some other grain crops, such as wheat, which requires more protein.

Question.— Is a lactometer test a fair one for milk; that is, cannot milk be treated so as to test pure, and still not be pure?

Mr. Smith.— If a person were practiced in it, knew how and had a lactometer, he could secure a test that appeared all right, and yet it would not be. The lactometer is an instrument with which to determine the specific gravity of milk. Skim-milk is heavier than whole milk, because the fat is the lighter. So that, if milk has been tampered with by watering or skimming, any one knowing anything about it, would discover it as soon as the instrument is removed. When the instrument is lifted from pure milk, that remaining on it runs off evenly and smoothly; if the milk has been tampered with in any way, the milk will run off unevenly and irregularly. We use the Babcock test and lactometer together. With them both it is easy to tell what the milk is. The Babcock test shows the per cent. of fat in the milk; the lactometer its specific gravity. If any fat has been removed, the lactometer will show that the milk has been tampered with, because its percentage or ratio of solids has been disturbed, while the Babcock test will show just how much fat there is in the milk.

Question.— What is best for corn, fall or spring plowing?

A vote being taken, resulted in favor of fall plowing.

Mr. Van Wagenen.— I am decidedly in favor of it. The action of the winter frosts breaks up the soil and better fits it for the crop. But, if the soil is too clayey, it may run together. My advice would be to experiment with the two methods, then decide for yourselves.

Question.— What variety of peas should you mix with oats for soiling, Champion or common white?

Mr. Chapman.— The small white Canada pea is the best for the purpose.

Question.— Take 10 acres of good, strong clay land, put it down in good shape, mow it once, divide it into two equal parts, one-half in day pasture, one-half in meadow, which mow five years, not later than July 1st, when not pasture, at the end of five years which half will be in the best condition to plow?

Mr. Dardis.— The part you mow, because that part will have the season from the 1st of July to recuperate, while the pasture has not one hour.

Mr. Smith.— If the cows are fed a proper grain ration, they will carry back to the pasture fully as much as they take away in fertility.

Mr. Lillie.— I incline to the belief that more loss will come from the land in pasture.

Mr. Smith.— If it is meant day pasture only, I guess the meadow will be the best.

Question.— What is the best way to dispose of the straw grown on the farm?

A Farmer.— Use it for bedding in the stables.

Another Farmer.— Get it into manure as quickly as possible.

Mr. Smith.— Cut the grain early, especially oats, before they begin to ripen. When the straw becomes too ripe it requires too much energy to digest it; there is too much wood fiber in it. Different grains have different straw food values. I believe that we should use a great deal of our straw for bedding and as an absorbent, inasmuch as the urine of our farm animals contains 60 per cent. of the manurial value of the voidings.

Mr. Irwin.— We cut our grain about the time the short straw begins to color. In that way a better feeding value is secured, as well as a better absorbent.

Question.— What is the greatest evil the dairy farmer has to contend with, that he tries least to remedy?

A Farmer.— Pulling daisies.

Another Farmer.— Scrub cows.

Mr. Dardis.— The pasture. There is, as a rule, nothing in it but weeds after July 1st.

Mr. Smith.— In some sections the "hawkweed" is the greatest pest. There are two varieties of it, having different colored flowers. It is hard to eradicate it. Salt, half a ton to an acre, sown in July, during a hot, dry time will kill it. But, if any of you have it, don't wait, but proceed to kill it at once. Cultivation of the land does not seem to do much that way.

Question.— How many cubic feet of air does a cow require in the stable?

Mr. Smith.— I don't know exactly; but I think about 500 feet.

Mr. Lillie.— It would depend very much on the ventilation of the stable. The air should be pure and the stable free of odors. There should also be plenty of sunlight present.

Question.— Can any one get a sample of any foods he may have, analyzed at the experiment station? If so, will he get a report of the same?

Mr. Smith.— No; if the station should attempt to analyze all the stuff sent to it, no time would be had for anything else. Besides, there would not be chemists enough. But, if you can get a good, fair, even sample of a suspicious food — one that there is no record of at the station — the director will make a careful microscopical examination of it, and, if he thinks best, will order a chemical analysis; not otherwise. If it should be analyzed the sender will receive a report.

Question.— Does a broad-tired wagon draw harder than a narrow-tired one? What width wheel is best for all farm work?

Dr. Smead.— For hauling loads over meadow or pasture ground, the wide tires are preferable; but, with hard, dry roads, I should prefer the narrow tire.

A Farmer.— We can draw 10 or 15 bushels more potatoes out of the field on a wide-tired wagon than on a narrow-tired one.

Mr. Smith.— Wide tires do not cut up the roads in a muddy time as do narrow ones; and if every wagon used on the road were wide-tired, the roads would be much better than they usually are.

Question.— What is the best way to get rid of quack grass?

Mr. Rice.— I had a piece of it. I summer fallowed the ground and sowed wheat. When the wheat came up I could not find a spear of quack. Plow the land early, but shallow; then run a cutaway harrow over it every few days. In other words, prevent the quack from growing; don't allow it to breathe. In this way one may subdue a piece of quack enough so that a crop of buckwheat or peas may be raised the same season, while the quack will have been killed out. In the fall sow wheat, and seed in the spring.

Question.— How shall we eradicate wild carrot?

Mr. Smith.— It is more difficult to destroy than is quack. Once it gets into the land, unless the land can be plowed and cultivated, there is no way by which it can be eradicated, as it seeds heavily and the seeds live a long time. Where a rotation of crops can be practiced, it may be kept in pretty good subjection. Prof. Jones of Vermont, says that the application of half a ton of salt to an acre, if put in when the weeds are very dry and hot, will kill it out.

Question.— Is it profitable to keep a cow after she reaches the age of 10 years?

Mr. Smith.— It would all hinge on the cow. If she is a good one, keep her as long as she is good for anything for the dairy.

Question.— Should farmers encourage reading-rooms or libraries as the means of educating their sons and daughters?

A Farmer.— It may be done, I suppose, and no doubt would benefit the farmer's boys and girls; but I hardly think it ever will be accomplished.

Question.— How can we kill out wild mustard?

Mr. Converse.— Where a rotation of crops can be followed, there is no trouble in killing it out. We plant corn on a clover sod, then use the weeder very thoroughly. It kills it out. If you have oats and peas that have mustard in them, use the smoothing harrow first, then follow with the weeder. It won't hurt the crop. If you have a boy, horse and weeder, keep all three going till the mustard has disappeared. Beside killing weeds, it conserves moisture which the crop needs, but which the mustard will take in part.

A Farmer.— I should like to ask Mr. Converse what he would do with land used exclusively for hay crops?

Answer.— That is another question. I should not follow that system, as my observation is that the man who grows hay mostly and sells it, soon becomes a poor man. Such has been the case up in Jefferson county.

Question.— Have you ever raised any soja beans, and if so, with what success?

Mr. Smith.— We grew some last year, but did not get as good results as from the cow peas. We put those with the corn into the silo.

Mr. Chamberlain exhibited a sample of cow peas on the vines, which were large, strong and green.

Mr. Rice.— The variety is known as Clay. There is another variety known as the Whippoorwill, which, he thought, was better.

Mr. Chamberlain.— I grew them to plow under for the purpose of getting humus into the soil. I had some plants that were nine feet long, last season. I do not consider it advisable to grow them for ensilage, as they are too expensive to harvest.

Question.— Would it be profitable to plow more deeply, and thus turn up some of the undersoil?

A Farmer.— I think that if the soil is deep enough it will do to plow deep. If not, it will not be a good plan.

Mr. Smith.— If one has always plowed at a shallow depth, and wants to go down farther, he should do so gradually, one inch a year. If he is radical and does as Horace Greeley did — goes down a foot the first time and so turns up subsoil — he will spoil his land for a while at least, because it will require additional humus and more manure to fit to grow good crops.

Question.— How do you account for it that in England, where the land is centuries old, they grow 60 bushels of wheat to the acre and other crops in proportion, while in America, where the land is comparatively new, only 30 bushels of wheat to the acre, and other crops in proportion are grown?

Mr. Woodward.— If the man who asked that question had read the agricultural history of England he would have learned that 30 years ago the yield of wheat there was only 14 bushels per acre, just about what ours is. The Englishman found out the secret, so began buying that which we let go to waste. He bought our cotton seed meal, wheat bran and oil cake to feed his live-stock. Result, the increase in the yield spoken of. Then, too, the Englishman is going to South Africa in search of protein foods and buying them there. In fact, he is buying them of every fool country that will sell them; then, when we look on and see the results, we ask how it all happened.

Mr. Smith.— Beside all Mr. Woodward has said, he might add that the Englishman is a good cultivator. He never does anything in a half or slovenly way, but gives the very best cultivation possible.

Mr. Woodward.— He does all this, and although some of the farmers are paying $30 rent per acre, they are making money each year.

Question.— Which do you consider the best authority, practical experience or theories from book farming?

Mr. Smith.— Practical experience is an excellent thing. Theories are of no benefit unless they are founded on facts. Practical experience is of no benefit unless it is right. Any other experience if followed up will lead one astray. The question is evidently aimed at the bulletins and is a misconception of their use. They simply record the results of carefully conducted experiments, some of which proved beneficial, some of which did not. There is no theory or book farming in the advocacy of the silo, nor in urging the spraying of fruit trees to kill insects and fungous diseases. You might just as well say the silo was a theory because you have never had one, when many of your neighbors have, and are satisfied with results; or reject the separator because you have never used one.

Question.— Which is the most profitable for the land, feeding hay and putting the manure on the land and feeding off the aftermath, or allowing the aftermath to remain on the land?

Mr. Smith.— When you remove a ton of timothy hay from the soil you take with it $5.75 worth of nitrogen, phosphoric acid and potash. Unless this plant food is restored the yield of hay will decrease. In some parts of the State where timothy is sold, the farmers have resorted to top dressing their meadows with manure; others take off but one or two crops of hay, then plow their meadows, take off two crops and reseed. But, when you feed off the aftermath, and do not put anything back the yield of hay will soon decrease to an unprofitable extent. The best way is to buy nitrogenous foods, save all the liquids and solids from the cows and put them back on the land.

To Mr. Woodward.— Are you in favor of cement floors?

Answer.— Cement makes a better floor than does anything else except one made of blue clay and gravel, which I like better. Cement is better than plank and will last a lifetime; but some people object to cement, because it is cold, but inside the barn it is no colder than any other floor. Cement is also impervious to water, thus preventing a loss of liquids by leakage. Cement sidewalks will last longer than will stone.

Mr. Smith.— The cement floors in the barn at the Geneva Station were put in 15 years ago. They have never been repaired and are now as good as when first laid.

Question.— Are the standard milk testers, in use at the present time, strictly reliable?

Mr. Smith.— I suppose you mean the Babcock test; if so, I will say it is perfectly reliable. The bottles and pipettes are all tested, and are found correct. I have made thousands of tests, compared them with chemical analyses in the laboratory, and found them to agree exactly.

Question.— Does the Babcock always test correctly?

Mr. Smith.— Yes; when the work is properly done and the acid is of proper strength. I have made a dozen tests from the same milk and found them to agree perfectly. The machine has been, and is being used in hundreds of factories in this and other States, giving entire satisfaction to all the patrons. If the test were not a fair one, it would have been discarded long ago.

Question.— Will the Florida velvet bean renovate the soil, as claimed by some writers? They say that one crop will bring up a field that has "been down." If so, how much?

Mr. Woodward.— That is what is known as the soja bean. It is not as good as the cow pea, and not so easily or safely grown. The hairy vetch is going to be the coming crop for that purpose; but, as yet, it is difficult to procure the seed.

Question.— What varieties of oats are best?

Mr. Woodward.— I have been raising "Early Swedish," several years. I like it best, but it will depend much on the quality of the land. Oats want a balanced ration. If the land is too rich in nitrogen, the oats will fall down. We apply potash and phosphoric acid to the land, because we have nitrogen enough.

Question.— Is there anything that will prevent peas from being stung, and will they grow after they are stung?

Mr. Smith.— A fly stings the pod, lays its egg inside, which hatches into a worm, which in turn becomes a fly. I know of nothing to prevent the stinging process, but the worm in the peas, as well as the fly, or other insect may be exterminated by the use of bisulphide of carbon. Put a little into a saucer or saturate a sponge with it, place it in the bin or bag, cover tightly and let it remain awhile. The sulphide throws off a gas which, being heavier than the atmosphere, settles and so penetrates the whole mass that it kills all animal life at once. All the large seed dealers employ it. It is also used to kill woodchucks, by placing a little of it in the hole in the ground and then closing the mouth tightly.

A Farmer.— In what sort of package does it come?

Dr. Smead.— It is put up in several ways; but the best is in sealed pint-bottles. Being highly volatile, unless it is kept sealed tightly it soon loses its strength. When the worm has eaten into the pea it spoils it, as the germ has been destroyed.

Question.— Should farmers favor the central township school in place of the district school?

Mr. Kreidler.— I will say, yes. Twenty years ago I taught country school, but changes have come. The teacher does not now have time to teach all the branches needed. Then, too, there are not scholars enough to keep up the country schools. Another point; teachers of sufficient caliber cannot be employed. Only normal graduates ought to be secured as teachers. The graded and high schools must succeed the country schools?

A Farmer.— In my opinion, we might as well, when the five o'clock whistle blows, all jump into a carry-all and go out to a boarding-house and get our dinners, as to take all the children into town and coop them into one building. Such a course takes all the individuality out of a child. The old-time schools turned out some pretty good men, and it is a question, in my mind, if Mr. Skinner's or Mr. Kreidler's plans will bring out better results. To-day, in every academy or school in this State where students are taking Regents' examinations, will be found those who can answer the questions propounded in Greek and Latin but cannot properly write seven lines in good English. Another point: Students go to Cornell, or elsewhere, to be educated, who are within a stone's throw of Alfred, where they can obtain fully as good advantages, or better, and at a less expense.

Another farmer said that the cost of maintaining the country district school was very small, not enough to debar the employment of good teachers. In his opinion, the day that witnesses the hauling down of the flag from the little red schoolhouse, will be the one that dawns on the death of the Republic.

It seems to be the only question of how to save expense, and to provide places for normal graduates. But, when it comes to forcing all the poor people to dress their children so as to properly appear among those in the village, they will never do it. It were much better to employ good teachers, if they do not have to look after half a dozen pupils. Let us keep the flag flying over the little red schoolhouse, and its doors open. "The best business men in Hornellsville, to-day, were educated in that little schoolhouse, and, if we keep it open and employ good teachers, it will turn out others fully as good."

Another Farmer.— That is my opinion exactly. The reasons advanced for such a radical change are *greed* and the finding of places for normal graduates. If carried out, a little less cost for tuition would result on one hand, while every teacher not a normal graduate, would be debarred from a position in the central schools.

Question.— Does it make any difference how wide we plow furrows, provided they are all well turned over?

A Farmer.— I think the narrow furrow is the best.

Another Farmer.— The more quickly we can plow the land the better, if we can do it well. I do not care if the furrow is two feet wide.

Opinions seemed to differ among the farmers.

Mr. Smith.— I should want every furrow well turned down. Then I would put on a heavy roller and roll it down closely. This to close up all air spaces. Then I should follow with the cut-away or spring-tooth harrow and fine the soil as much as possible before putting in the crop.

Question.— What ought a farmer's wife to do if her husband will persist in having the pigs run in the dooryard?

Mr. Lillie.— In that case, if the wife objects, I think she will have good cause for instituting divorce proceedings at once.

Question.— What soil is best for growing black seed onions, and how early should they be sown?

Mr. Smith.— Near Canastota, onions are grown on a black soil. In other places they are grown on other soils, and it is claimed that the quality of the onion is better than that of those grown on the black mucky soils, because the onions are not so strong. I know a man who grew last season 900 bushels of onions on an acre, which he sold for 60 cents per bushel. Sow as early as the ground can be prepared in spring.

Question.— What shall we do to secure free mail delivery?

Mr. Smith.— As I understand it, a petition must be forwarded to the Post-office Department at Washington. It must be unanimous. Then, if all is satisfactory, the Department will send an agent, who will look over the ground, and, if he reports favorably, the system will be adopted on that route.

Question.— If a soil has plenty of potash, phosphoric acid and nitrogen, will it be fertile?

Mr. Smith.— No; unless the plant food is available. If it is locked up in the soil, it is of no benefit. To unlock it, there must be vegetable matter in the soil to hold moisture. This moisture is necessary to dissolve the plant food elements, as plants feed on "soup" — dissolved plant foods mixed with water.

Mr. Woodward.— If the soil is hard, so that air cannot reach the plant roots, the plants will not grow. They require air just as much as we do. There is another condition under which some plants will not grow; that is when the soil is sour. Lime or ashes applied broadcast and turned under will correct this acidity.

Question.— At what temperature should a stable be kept in winter?

Mr. Goodrich.— Opinions differ among dairymen on that point. I heard a man say recently that he never allows his stables to get below 70 degrees. But I think that too high, as, when the stable door is thrown open, when the mercury is below zero, the change is too great. My plan is to keep an even temperature and above freezing, not allowing it to go below 40. Don't crowd the stables with too many cattle, and have plenty of pure air. Make the stables as comfortable as possible.

Alson Cook.— I should make the temperature of the stable from 45 to 55 degrees. When you reduce the temperature below 45, I think you make a mistake, if you are making milk, which we are trying to do in winter.

Mr. Richardson.— I am in favor of having the stables kept above the freezing point, and I should not turn a cow out when the thermometer is below zero. When you do that, she will shiver nearly all day when she is again put in the stable. I know that the average cow will give more than 1,000 pounds more milk in a year, when she drops her calf in the fall, if she is kept in a comfortable stable and well and properly fed.

Question.— How may a farmer utilize all the old bones lying around on his farm without a machine for grinding them?

Mr. Woodward.— If he has good hard-wood ashes, and will break up the bones finely, then put in a layer of ashes, then one of bones, and alternating, into an old kettle, and will keep the mass moist enough to extract the lye from the ashes, in three months the bones will be nearly dissolved. At that stage, sift the mixture. There will be a few pieces left; break these and go over the process again. You will then have a very good fertilizer.

Question.— How many Canada peas should be sown on an acre?

Mr. Woodward.— As a rule, a bushel will be enough.

Question.— How can we exterminate the sparrows?

Prof. Lowe.— I don't know. They might be poisoned, but such a course would endanger other birds.

Mr. Fenner.— I fed a flock of sparrows poisoned grain, but I don't know how many I killed. The poison blew on to adjacent land and poisoned a lot of valuable chickens.

Prof. Lowe.— In some places in the West a bounty is offered for dead sparrows, and some boys earn considerable money by shooting them; but, in some way, the number does not seem to decrease to any great extent.

Question.— Is there any law that can be enforced to destroy the caterpillars that infest the trees along the road side?

Prof. Lowe.— I do not know of any such law, and yet there may be.

Mr. Fenner.— I think we have a law on our statute-books that includes the tent caterpillars on trees along the road sides. All that is necessary is to enforce it.

Question.— Does it pay to hold Farmers' Institutes where people practice only old methods?

Mr. Van Alstyne.— I think that the best place to hold them. They need more light there. There are some people who expect too much. Then there are those who reject everything, while another class jump at every new thing that comes along.

Question.— About how long will it take to make a Babcock test correctly?

Mr. Grunder.— It requires about 10 minutes to make a test, and some skill to do it; but it may be easily acquired.

Question.— What effect has lime on soil, and how shall we know when it is needed? How should it be applied?

Mr. Smith.— Lime has the power of liberating plant food; it also corrects any acidity in the soil. If you are suspicious that the land is sour, test it with blue litmus paper. Prof. Wheeler of Rhode Island, says he applies a ton to a ton and a half of lime to an acre once in four years.

Question.— What variety of pea is best to sow for an early market crop?

Mr. Smith.— "Knotts Excelsior" is the variety mostly grown in some of the pea and bean-growing towns in Jefferson county, this State.

Question.— Which is the best for corn and potatoes, the weeder or harrow?

Mr. Rice.— A little of both. The weeder is not heavy enough for hard, heavy ground. It is a good thing to use to stop weed seeds from germinating and for covering clover seed. We also use it on our potato ground, even after the potatoes are up. We also use it on our strawberries, but they must be used early. For heavy work to break the crust and prevent the moisture from getting away, we use the harrow.

Question.— Would you advise using a weeder on new seeding that had been top-dressed during the winter, the object being to scatter the lumps that had been frozen? Which is the best one?

Mr. Dawley.— I should want to see the field before I gave an opinion, but I should not want to put frozen lumps of manure on the land. Would prefer drawing it out and spreading it as fast as made. I do not believe a weeder would break up such lumps. I think a smoothing harrow would be better. There are a number of weeders on the market; all are good; but I do not see any material benefit of wheels on one, nor would I buy one too light.

Question.— What is the best variety of pea to sow with oats for hay; what is the best way to put them in?

Mr. Smith.— The best pea for the purpose is the small Canada pea. Put them in four or five days before you sow the oats.

Mr. Woodward.— We plow our Canada peas under to a depth of four inches, sowing a bushel to a bushel and a half per acre. Four or five days later we drill in the oats, going across the field.

Mr. Dawley.— If one is to sow oats with peas, select some one of the strong growing varieties. Too many farmers have become disgusted, when trying to grow them, from having selected some one of the feeble-growing varieties.

Question.— Is it right to confine cattle in stables from early fall till spring, with no exercise except as they are let out to drink?

Mr. Gould.— Yes and no. It is better to allow cows, which are kept in dark, damp stables, to go out every day, because the air is purer out there. But, if the stables are well ventilated and are dry and light, unless the weather is very mild, the better place for the cow is in the stable. We keep our cows in the barn most of the time in winter, and have never had a case of tuberculosis in the herd, some of which are 13 years old.

Question.— What is the best remedy for exterminating the brake weed?

A Farmer.— Cultivation, if you will stick to it, will kill it.

Mr. Smith.— That is true. Cultivation will not only kill brakes, but every other plant, if persisted in thoroughly.

Question.— How can we best destroy "paint brush," or "red weed"?

Mr. Smith.— Hawkweed was originally grown because of its beautiful flower; but it got loose, "ran wild," and has become very difficult to drive out. The seed lives a long time in the ground, and so requires pretty thorough attention to eradicate it. Cultivation will do it in time, but there are many places where the land cannot be cultivated. On such land, salt will kill out the plant. A half-ton of salt, sown broadcast per acre, when the weather is hot and dry, will take out all the moisture from the weed, and so kill it; but it must be put on when there is no moisture on the surface of the ground. Prof. Jones of Vermont, is an authority for this statement.

A Farmer.— Will not the salt kill out *all* the grass?

Mr. Smith.— There won't be any grass there, nor anything else but hawkweed; you may be assured of that.

Mr. Woodward.— The salt will be worth all it costs for releasing locked-up potash in the soil.

Mr. Smith.— Whenever a farmer finds a few stalks of a noxious weed on his land, he should at once destroy them. "Paint brush" originally came from Switzerland.

Question.— Has the experiment station found any preventive for the wire worm working on potatoes?

Mr. Smith.— Fall plowing and a rotation of crops will kill wire worms. A farmer at the Franklinville Institute said, in reply to such a question, that he had never failed to kill all wire worms through the use of buckwheat. He first grew a crop for the grain, then followed it with one to plow under. The last one was allowed to fall down and rot. The next spring, when he plowed the ground, there were no wire worms. But the wire worm does not work on potatoes. What we see is the work of the scab fungus — not the wire worm.

Question.— What will destroy smut in oats?

Mr. Smith.— Soaking in water at a temperature of 132 degrees kills the smut germ. If the water is below that degree, the smut germ will not be killed; if the degree is higher, the life germ of the oat will be killed. Thus, it will be seen that much care must be used in "soaking" the oats. Ten minutes is long enough for the process. Remove the oats, spread them out and allow them to dry.

Question.— What is the analysis of bean straw?

A Farmer.— About one and a half less than has clover hay, in protein.

Mr. Witter.— Cornell Bulletin 104 gives the analysis of bean straw and pods.

Mr. Smith.— There is quite a little difference between the analysis of bean pods and straw. The former is the richer.

Question.— How many tons of mangels can be grown on an acre of good ground?

Mr. Woodward.— Anywhere from 10 to 30 tons, according to the richness of the ground, and the care one gives the crop. We grow Long Red for early feeding, and Golden Tankard for late. There is not much difference in their yields.

Question.— Which bird is the farmer's best friend?

Mr. Gould.— That poor, persecuted crow. I know no bird which is such a farm scavenger as is the crow. He takes all the cut worms, and, when we scatter a half-bushel of white corn in a furrow for him to work on, he will take one kernel at a time and fly away to the woods with it where he buries it and waits for it to sprout, when he eats it.

Question.— What about the forest tree worm, we have heard so much about it; what is a preventive?

Mr. Smith.— They are bad worms and, where they appear two years in succession they nearly or quite kill the trees. They can be fought on fruit and shade trees, but, in the forest, it is impossible to reach many of them.

Question.— What should be the length of plank for a cow-stable floor, with swing stanchions, and mangers?

Mr. Witter.— I don't know. Our stable floors are made to conform to the size of our cow. About five feet four inches is the average length of the plank.

A Farmer.— My floors are four feet eight inches.

Mr. Smallwood.— My floors for Jerseys are four feet four inches, but my Jerseys are not all of the same length.

Question.— Which is the best turnip for table use?

Mr. Gould.— There are a number of varieties. We grow the purple top, strap leaf.

Mr. Jennings.— Some of the white Swede varieties are preferred for table use.

Question.— Would you use a weeder on winter wheat after sowing grass seed?

Mr. Woodward.— It would depend on the state of the wheat. If it had begun to stool out, I should use the smothing harrow because I could slant the teeth back so as to cover the clover seed and not lift the wheat out.

Question.— What is the best crop to raise on our farms?

Mr. Litchard.— The best crop ever grown on my father's farm was one of boys.

Question.— How much salt shall we apply per acre?

Mr. Smith.— What do you want to apply salt for? It has no fertilizing value whatever; but sometimes there is locked-up potash in the soil which salt will set free. It also helps to furnish moisture, but too much of it not only sets too much potash free but burns up the vegetable matter in the soil.

Question.— Is a rotation of crops advisable in order to keep up the fertility of the land, using, say, corn, peas and clover?

Mr. Mann.— It certainly is. If I have clover I turn it under and plant corn. I have followed a rotation during several years, and find that my land is improving.

A Farmer.— My farm is at least twice as productive as 20 years ago, but I cannot say that it is wholly due to a rotation of crops, because I have not practiced any fixed rule.

Question.— What is the cause of the blight on cabbage?

Mr. Rice.— No remedy has as yet been found, although experiments have been tried at the Geneva Station. Write to Prof. Stewart at the station. He will give you the results so far as he knows.

Question.— How should peas be sown? How much seed per acre?

Mr. Cook.— What is your opinion, farmers?

A Voice.— Drill them in, going both ways.

Another Voice.— The best crop I ever grew was plowed in four inches deep.

Mr. Cook.— I have succeeded fully as well by drilling them in as by plowing them under. We grow the small Canada peas, but we drill them in. If the soil is very mellow and nice, there is no difficulty in getting them in at a uniform depth.

A Farmer.— A common drill will not sow them thick enough, unless we go both ways, and sow four bushels to the acre.

Question.— What about cow peas?

Mr. Cook.— I have never grown them, but will try them next season.

A Farmer.— How can we grow them on quack grounds?

Mr. Cook.— It takes considerable work. We put four horses on a disc harrow last spring every day for nearly four weeks, on a field where we planted ensilage corn, but we conquered it — the quack, I mean. To kill quack, stop it from growing above ground. Good cultivation will kill any plant, but I believe that quack is a good thing in one way, at least, because, through its root growth it furnishes vegetable matter for the soil, and quack root is as good as any, except that it does not furnish nitrogen as does clover.

Question.— Does it pay to plow potato or corn ground in the spring, for oats?

Mr. Gould.— No. I have got through plowing ground in the spring, for oats.

Question.— How many cows will a 40-acre farm, under good management, support?

Mr. Woodward.— Forty.

Mr. Smith.— Fifteen acres of ensilage, if it is good, will keep 40 cows. Add to that six acres of alfalfa and you have the coarse food part, leaving 19 acres for other purposes.

Question.— Would it be profitable to sow rye in corn, to be plowed under the following spring on land to be sown to wheat the next fall?

Mr. Rice.— It certainly would pay to have such a crop to plow under the next spring, as it will hold moisture for the benefit of the wheat or other crops that would follow.

Question.— What was the yield per acre of your oats last year? What was the variety sown?

Mr. Smith.— We did not grow any clear oats last year. We had oats and peas to quite an extent, cut early and fed green. If the question refers to the Geneva Station, I can give no further information.

Question.— How do oats and peas compare with other forage crops?

Mr. Smith.— Not at all with alfalfa; but we could not have carried our animals through the last summer without our silos. The season last year was so dry that we were obliged to rely on the silo. The young stock got the alfalfa, while the cows got the ensilage. But, one season with another, alfalfa is our best forage crop. Over in Onondaga county much of it is grown, and it is worth there now $18 to $20 per ton. (February, 1901.)

Question.— Would you advise putting cement floors in a wagon-house?

Mr. Smith.— I do not know, but for stable floors they are preferred to plank floors by many farmers.

Question.— Why do tomatoes rot on the vines?

Mr. Rice.— It is caused by a fungus. As a rule, where the tomatoes are in the shade or near the ground the rot fungus appears first. It is better to set plants on ground where no tomatoes were grown the year before. One had better do that than fight the rot fungus with the spray pump and Bordeaux mixture. The same is true of cabbage. If "clubfoot" has appeared in cabbage do not set plants on the same land the next season.

Question.— Which pays the farmer best, hay at $10 per ton or butter and cheese at present prices?

Mr. Smith.— If you want to be driven off your farm, keep no animals but sell your timothy hay; when you sell a ton for $10, you only have $4.25 left after deducting the value of the plant food in it. If, however, you have a silo, keep animals, and will save all the manure and return it to the soil, you may sell timothy and not impoverish the farm.

Question.— What are the benefits in the use of a weeder in corn and potatoes and for covering grass seed?

Mr. Smith.— The thorough preparation of the soil is of great value; but it won't make good land out of poor land. The first need is good physical condition; this is brought about by incorporating humus into the soil. This done, use the cultivator and weeder, to fine the soil and bring up the moisture; also to prevent it from escaping by evaporation. It will then be held by the vegetable matter, and thus make plant food available. Prof. Roberts grew crop after crop of potatoes without any fertilizer, in this way, the soil having first been thoroughly supplied with humus.

Question.— How many cows may be kept on 10 acres of ensilage?

Mr. Smith.— Twenty-five.

Question.— How does buckwheat rate as a green forage crop for milch cows?

Mr. Goodrich.— We do not grow much buckwheat, except for grain.

Mr. Van Wagenen.— Considerable buckwheat is grown in Schoharie county, but not much is used for that purpose. I do not believe it would be practical so to use it here.

Question.— Is millet hay as good as timothy for young or dry live-stock?

Mr. Goodrich.— Millet produces a good food, but it must be cut early, before it becomes hard and woody. We sow it early, say in June. It is a difficult hay to mature. So that, if the weather is unfavorable, it is a hazardous crop to grow. We prefer the German to the Hungarian variety. It contains more protein than does timothy.

Question.— I have a corn stubble field fall plowed. I wish to sow oats and peas and seed it for two or three years. Shall I sow alfalfa or clover? Also a hillside in wheat which I wish to seed for a permanent pasture. What seed shall I sow on it, and when?

Mr. Woodward.— I should certainly sow the red clover. If the land is poor I should sow the large variety; if it is rich I should sow the medium red. For permanent pasture, some of the fescues and white clover. Orchard grass if kept pastured close, makes a good permanent pasture, while blue grass is excellent for a hillside pasture. In England the fescues are largely used, but they feed the pastures all the time, and I never saw such fine pastures anywhere as I saw there. It is a good plan to go over the pasture with a harrow and re-seed it occasionally.

Question.— Is humus absolutely essential for the good of the soil?

Mr. Goodrich.— Humus is decayed vegetable matter, and must be dissolved, and which, when combined with plant food, builds up the plant. I do not think we can grow any plant unless we have some humus in the soil.

Dr. Curryer.— What is soil without humus? Is it anything more than pulverized rock?

Mr. Rice.— Nothing more. That is it, exactly. All soils are pulverized rock, made productive by the addition of humus, which, as Mr. Goodrich says, is decayed vegetable matter, or what we term humus.

Question.— Will it do to sow rape seed in winter wheat when it is thin?

Mr. Woodward.— No; but it may be sown in the corn at the last cultivation for late feeding, or it may be sown alone at that time. If for early feeding sow it about the time oats are sown.

Question.— How shall we destroy the wire worm the most easily?

Mr. Witter.— Turn the land over — plow it — just as late in the fall as can be done. This will expose the worms to the action of the winter frosts. It will also kill the white grubs and cut worms. Salt will not kill wire worms. They have been known to grow and thrive well in a barrel of salt.

Question.— Do English sparrows eat grubs and other injurious insects that prey upon the farmers' crops?

Mr. Smith.— I think not. As a rule, they are not guilty of doing anything of such value.

Question.— Shall we cut corn stalks or feed them whole?

Mr. Lillie.— By all means, cut them, else nearly all the feeding value below the ears will be lost.

Question.— What crop can a dairyman most profitably grow to produce his own protein? What about the southern cow pea, or soja bean?

Mr. Witter.— Probably the best crop which can be grown, is alfalfa. It is very rich in protein, having a ratio of 1 to 3.5.

Mr. Smith.— Prof. Voorhees of the New Jersey Experiment Station, produced $107 worth of protein in alfalfa on one acre of ground, taking wheat bran as a basis.

Mr. Witter.— We have found alfalfa along the Lake Ontario region. I know nothing about the soja beans.

Question.— How about cow peas?

Mr. Smith.— We have grown them on the Geneva Station farm, but they were mixed with corn and put into the silo.

Question.— Will Mr. Smith tell us about varieties of cow peas? For what are they valuable?

Answer.— They are very valuable as a catch crop for building up a depleted soil. They are practically a bean and one must be careful with them. We grew them last year at the Geneva Station and put them into the silo with corn. They balance up the corn well.

Question.— Does any one present know that wheat will turn to chess under certain conditions?

Mr. Smith.— There is a standing offer of $50 for a plant of wheat which has changed to chess, and the award has never yet been claimed.

Quite a discussion ensued on this question, some farmers claiming that they knew in their own experience that a crop of chess had come from a seeding of wheat.

Question.— What do you think of oats for feeding, especially for fattening old animals?

Dr. Smead.— I think they are a grand good food, and I am going to say, that within the next five years more of them will be fed. To-day, only the trotting-horse men seem to know their value. As to fattening, they should be fed in connection with corn so as to create lean meat, which will make a nice juicy steak, which corn alone will not produce. At a Chicago stock show, the steers that won highest prizes were found to have been fattened on oats and corn. It will pay to grind the oats, however, for such feeding.

Question.— How about cow peas; what are they good for?

Mr. Gould.— They are a remarkably good crop to plow under to grow another crop on. I tried them as a green crop, but somehow, my cows did not like them. When I was in Georgia, I saw the cows there eating them all right, and the farmers told me I did not "stick to 'em" long enough or mine would.

Question.— Shall we seed with the oats or in the fall after cutting the oats?

Mr. Witter.— I should sow the seed in the spring, when sowing oats.

Mr. W. Peck.— I plowed my meadow land, harrowed, and drilled in corn and grass seed. I cut the corn, and had a good seeding of timothy and clover on the land. The seeding was top-dressed with manure in the winter, and I obtained a good crop of hay. I have largely increased my live-stock in this way. I sow corn and grass seed at the same time with the grain drill. Run the grass seed in drills a few inches apart, and the corn in drills about three feet apart. The corn cannot be cultivated with this plan. The corn makes fair growth.

Question.— Which is the better way to keep up a farm; to keep all the live-stock possible, or to buy commercial fertilizers?

Mr. Witter.— Keep live-stock. In sections that have depended upon commercial fertilizers the farms are becoming less productive. The starch foods can be raised upon the farm. Buy those which are rich in protein.

Question.— How do you fit your land for cow peas? How much seed do you use per acre and what is the cost?

Mr. Gould.— The price last year was $1.75 per bushel which was unreasonably high. Fit well; sow about May 20th; drill two or three inches deep. Roll after sowing, harrow once to keep ground from crusting. Use only the Clay or Whippoorwill varieties.

Question.— How can we get the most value from our oats, to cut green for hay or to thresh them?

Mr. Witter.— Our practice is to raise oats and peas, using one bushel of Canada peas to two of oats. Drill them deeply. Cut them while partly green. If carefully cured, the straw after threshing will make good hay and there will be less waste than when the grain is fed with the straw.

Question.— Is it not better for all animals to have exercise in the open air on sunny days?

Mr. Gould.— Milk giving is a product of nerve force. If the cow gives two pailsful of milk a day, she works as hard as any horse. Make her comfortable, give her good food and ventilation and she will in her milk production get all the exercise necessary.

Question.— What will keep smut from sweet corn in the garden?

Mr. Witter.— There is no preventive known. It is not injurious to live-stock, as was formerly supposed.

Question.— How can you compute the quantity of hay in a stack?

Mr. Witter.— The ordinary rate is 512 cubic feet for one ton. It will depend on the fineness of the hay.

Question.— How shall we mix oats and peas for sowing?

Mr. Witter.— One bushel of peas with two and one-half of oats.

BARN MANURE AND SOME OTHER FERTILIZERS.

Question.— How can we get best results from farm manure?

Mr. Johnson.— My practice is to haul it from the stable every day and spread it, either on new seeding or on land I am going to crop. I prefer to plow in the fall; draw out the manure, spread it and in the spring harrow or cultivate it in.

Mr. Bentley.— I get good results from plowing manure under for corn, and I am going to plow as much of mine under as I possibly can.

Mr. Smith.— Mr. Gould, when he comes, will tell you that is the ideal way to grow corn.

Mr. Bentley.— Is Mr. Gould a good farmer?

Mr. Smith.— Yes, sir, he is; a very good farmer indeed. But I want to say right here, that unless one has vegetable matter in his soil to hold moisture, he will not be able to grow good crops, no matter how much fertility there is in it. Corn stalks, straw, clover or other such crops are valuable for that purpose. As a rule, sandy or gravelly soils are most destitute of humus. This is why moisture leaks out of them, and we find so little response from fertilizers applied to them. I recall a farm that a few years ago, was called a "run out" one. A young man bought it at a reduced price and began sowing clover and applying straw, both turned under; to-day it is one of the most productive farms in that section.

Question.— Will there be any loss of fertility in manure spread on land in winter?

Mr. Smith.— Unless the manure is washed away or fermentation sets in, there will be no loss in that way. The mineral elements — potash and phosphoric acid — might possibly be washed out on a very steep hillside; but there would be no loss of nitrogen, until the manure had heated up. I do not remember the degree of heat it has to reach to change nitrogen to ammonia, and thus allow it to escape.

The question brought out a variety of opinions as well as several side questions as to the best way to utilize manure, opinions differing somewhat.

Question.— Will not manure spread on top, hold moisture as well as that which we plow under?

Mr. Smith.— It probably would hold surface moisture, but we have two objects in view when we plow under manure — the first is to add fertility to the soil for the benefit of the crop which is to follow; second, to furnish humus to hold moisture to liberate the plant food already in the soil, as well as that in the manure.

To Mr. Cook.— How do you apply manure?

Answer.— During the winter we draw out the manure every day and spread it where we are to grow corn the next year. That made during the summer we use to top-dress grass land. We use a disc harrow on our corn ground, which has been plowed six inches deep. I want to stir those furrows just as deeply as I can and not turn them upside down.

Question.— If manure is drawn out every day in winter, will it lose any of its value?

Mr. Cook.— No; unless it has been spread on a very steep hillside. In that case, should heavy rains come, some of it may be washed down into the valley. As a rule, however, there will be no loss. Such has been the result of our experiments and observations.

Question.— Shall I pile or spread my stable manure in the field?

Mr. Smith.— What do you say, farmers?

A Farmer.— Spread it.

Another Farmer.— It will depend. If the land is level, spread it; if rolling, leave it in piles.

Mr. Smith.— As a rule, manure will not waste when spread. If you were to draw out a load of manure to-day and spread it on this snow, do you think there would be any loss?

The Farmer.— It would depend on the lay of the land.

Mr. Smith.— We increased the yield of hay on a quite hilly field where we drew out and spread the manure every day in winter. We increased the yield of hay from one to two tons per acre. The trouble is, when manure is left in piles, the farmer does not spread it until he gets ready to plow the ground. The result is an increase of fertility of the soil under each pile. The man who draws the manure from his barn and spreads it every day gets most benefit from it.

Mr. Lillie.— We draw the manure every day in winter and spread it on our clover sod where we will plant corn next year. As a rule, we do no fall plowing. There are several reasons for not doing it. One is that we cannot draw manure on to fall plowed land in winter, particularly, when the ground is covered with snow.

Dr. Smead.— Draw it directly to the field every day. It does not improve by being left in the stable, and there will be no loss unless the temperature reaches 70°. If you can't draw it out because of snow, keep it under cover. It will pay to build a manure shed to keep off rain. It may freeze badly and give you some extra work to get it out.

A Farmer.— I prefer to draw it out and pile it.

Mr. Chapman.— Why not spread it if you can draw it out and pile it? There will be more loss from piled than spread manure.

Question.— Will fertilizers lose any value by being kept one year, if kept in a dry place?

Mr. Chapman.— I think not.

Question.— Will it injure barn manure to draw it out when frozen hard?

Mr. Woodward.— No, sir; not at all. The best thing to do with barn manure is to put it on the land just as soon as made. Two loads of such manure is worth three kept and applied in the usual way.

Question.— How can we save our horse manure all summer, to apply on wheat land, and retain its full value?

Mr. Witter.— I don't know.

Mr. Smith.— If horse manure is kept piled and land plaster is mixed in it, if the pile is kept solid, there will not be much loss of nitrogen caused by fermentation.

Mr. Gould.— It will require lots of land plaster and road dust to hold the nitrogen in such manure, which gets away in the form of ammonia.

Question.— If manure is plowed under, does it do as much good as if spread on top? If not, why not?

Mr. Smith.— If you have fine manure and want to get an immediate return, putting it on top and harrowing it in will give most present benefit. If you want later results, that is, to permanently enrich the land, plow it under.

Question.— Is South Carolina rock good for barley? If so, how much per acre?

Prof. Cavanaugh.— I do not believe that South Carolina rock is needed any more for barley than for other grain crops.

Question.— What is the best fertilizer for spring wheat?

Mr. Litchard.— On heavy, damp soil, stable manure has no equal for this purpose. And right here let me say, I believe, even in a dairy region, it would pay the farmers to give more attention to wheat raising; for on every farm may be found more or less land suited to its growth, and the stable manure is furnished by your herds. In fact, I believe it would be greatly to your interest to give more attention to mixed farming. We are living in what may be said to be an age of specialties, yet I believe farmers make a mistake when they confine themselves entirely to a single line of farming. First, it is bad for the land. In any locality where only some specialty is followed, the soil almost universally becomes poorer; second, it is bad for the pocket. I find that, with me, mixed farming is more profitable, and this has been, I believe, the general experience of those who have given it a trial. Finally, it is bad for the mind. There is too much tendency among all classes to think along only a single line. In any department in life, the old adage, "Variety is the very spice of life," may be well applied and is as applicable to the life of the farmer as any other class. It is the men of thought, of push and of variety that help us along.

Question.— What brand of fertilizer is best to use on clay or hardpan soils?

Mr. Smith.— The "Barn Brand." As a rule, the lack in clay land is vegetable matter. There may be a plenty of fertilizer in the soil, but it is locked up. The humus has gone out, so that moisture is not held. Unless there is moisture, which cannot be present without vegetable matter, plants cannot feed. It is useless to apply commercial fertilizers unless there is moisture to make the plant food in them available. The sowing of some form of catch crop, like clover, rape or rye, with the barn manure, will furnish humus. Our best farmers are sowing some cover crop, to be plowed under the next spring.

Question.— What is the best fertilizer for vines?

Mr. Rice.— What variety of vines? If tomato, nitrate of soda or stable manure is good. But neither might apply to others. Every plant has two growths, one a reproductive, the other a fruitful one. Both should be considered. Study the soil and the plant. If the gentleman who asked that question will state what vine is meant, I may be able more fully to answer it.

The Questioner.— I had reference to cucumbers.

Mr. Rice.— We grow them for pickles, using a large shovelful of stable manure under each hill. If anything more is required, we apply some nitrate of soda, harrowed in when planting the seed. If applied after the plants appear, unless great care is taken, it will burn the foliage. Probably 200 pounds of nitrate of soda will be enough for an acre. We use 100 pounds on an acre of strawberries.

Question.— What is the best fertilizer to produce fruit?

Mr. Rice.— Ordinarily speaking, we need all three elements of plant food for most crops in most soils. The only way is to experiment and find out. For some crops in some soils, only nitrogen is needed; in others, both potash and phosphoric acid should be applied. On our soil at home there are more than 55,000 pounds of potash on a surface foot of an acre, but it needs both nitrogen and phosphoric acid. Read the language of the plant; study it and the effects of fertilizer on it. In this way, and in this way only, can we tell what is most required. No one can come here and lay down an iron-clad rule for fertilizing any crop.

Question.— What is the best commercial fertilizer for strawberries?

Mr. Smith.— That is a broad question. I cannot answer it without knowing the condition of the soil. If you have a good clover sod, well fitted, not much nitrogen will be required. As a rule, a fertilizer made up of three per cent. nitrogen, seven of phosphoric acid and nine of potash gives good results. This is Dr. Van Slyke's formula. Conditions, however, and different soils may require a different formula.

Question.— What fertilizer would you recommend for grass land which was in hay; that is, what chemical fertilizer?

Mr. Smith.— A dressing of 100 pounds of nitrate of soda per acre, applied early in the spring, will, no doubt, give best results, as it is very soluble and at once available for the use of the plant.

To Mr. Stevens.— Give a good formula of fertilizer for strawberries?

Answer.— Wood ashes are valuable. Do not put on nitrate of soda, except early in the spring, else it will burn the foliage. A fertilizer made of 400 pounds of muriate of potash, 400 pounds of acid phosphate, 200 pounds of nitrate of soda per acre will be found good.

Question.— What effect has potash on fruit trees?

Mr. Rice.— Potash makes a hard, stocky growth of wood, and gives color to both leaf and fruit. Nitrogen, if too much is applied, makes a soft, unhealthy growth, while phosphoric acid perfects the seed. If I had an orchard that was making a good, healthy growth, I should keep nitrogen out of it. It is quite easy to ascertain what element of plant food is most needed by a plant or tree by observation. If the tree or plant is making a feeble growth and looks pale and "puny," nitrogen is needed; if the grain or grass falls down, or the wood of the tree is soft and overgrown, there is too much nitrogen available in the soil. If the leaf, fruit, grass or grain lacks in strength, potash is needed; if the fruit prematurely falls, or does not make a full growth, the seed has not perfected. In that case phosphoric acid is required.

Question.— When an apple or potato rots on the ground, does it carry back the same plant food it took away from the soil?

Mr. Rice.— Yes, in a way. If the apple were to rot, the mineral element in it would go into the soil, while some of the nitrogen in it might turn to ammonia and escape into the atmosphere.

Question.— Give value of good hard-wood ashes? How should they be applied, and what crop is most benefited?

Mr. Smith.— Good hard-wood ashes, if they have five per cent. potash in them, are worth about $6.75 a ton. The potash will be about 100 pounds, worth five cents per pound, and 30 or 35 pounds of phosphoric acid, worth $1.75. But there are many so-called Canada ashes that will not analyze more than three per cent. of potash. But there is a little more value, which is the lime in them. The lime promotes a certain chemical change in the soil by releasing plant food locked up. As a rule, potash and phosphoric acid are more cheaply obtained in another way. Buy 200 pounds of muriate of potash, 200 pounds of treated South Carolina rock and 1,600 pounds of slaked lime. Apply half a ton per acre on ordinary soils for ordinary crops. I do not know what crops will be most benefited by their use.

Question.— Are ashes good for corn, and when and how should they be used?

Mr. Smith.— Yes; their value is in the potash and lime contained in them. Corn does not require as much potash as some other crops; but, for a crop of 60 bushels per acre, 100 pounds of nitrogen is required. The lime in the ashes sweetens the soil, if there is acid in it. It also sets locked-up plant food free. As a rule, however, potash and phosphoric acid may be bought more cheaply from other sources than in ashes. There is about one per cent. of phosphoric acid in ashes. If you decide to buy them, do not pay more than $6.50 per ton, and insist upon a guaranteed analysis. Sow broadcast in the spring.

Mr. Cook.— It will depend on the quality of the ashes. Good hard-wood ashes, if well preserved and kept dry, may be worth, possibly, $7 per ton. They will analyze about four per cent. potash and one to one and a half per cent. of phosphoric acid. Then there will be nearly $2 worth of lime in a ton of them.

Question.— What do you think, Mr. Cook, of mixing poultry manure with ashes?

Answer.— You will lose all the nitrogen in the manure. The lime in the ashes will set free the nitrogen in the manure, which will escape in the form of ammonia. Do not mix lime or wood ashes with any manure. Land plaster will do, however.

Question.— How much wood ashes would you recommend for an acre?

Prof. Cavanaugh.— I don't know; I suppose that 25 or 30 bushels would not be too much.

Question.— About how many bushels of ashes would you use on an acre of apple orchard?

Mr. Gould.— I heard a man say recently that he wanted 100 bushels of good ashes on an acre of peach orchard. He did not say anything about apples.

Question.— Would you sow land plaster on newly-seeded land so as to save the plants?

Mr. Rice.— Land plaster contains no fertility. Its value is in its ability to unlock plant food already in the soil. On virgin soil it is valuable for this purpose. But I should try South Carolina rock in place of plaster. At the present price of rock, for that containing 14 per cent. of phosphoric acid not far from $14 per ton, you will get the plaster free. That portion left after deducting the acid is pure sulphate of lime, which is land plaster. If you buy it, insist on a guaranteed analysis, and don't pay $14 for $11 grade.

Question.— Why does not land plaster stimulate the growth of clover, as it once did?

Mr. Smith.— Land plaster is an indirect fertilizer, and, if the land has enough humus, some benefit will be derived. The sulphate of lime in it, on such soils, will set free potash. Land plaster makes a good absorbent in the stable, because it locks up and holds nitrogen in it, which otherwise would escape in the form of ammonia.

Question.— What is the cost of South Carolina rock?

Mr. Smith.— It is worth about $14 per ton for the best quality analyzing 14 per cent. of phosphoric acid. But there are some dealers who sell 11 per cent. rock at the same price as 14-per-cent. goods. If you buy it insist on a guaranteed analysis and do not pay any more than it is worth.

Question.— What is the cost of dissolved South Carolina rock?

Mr. Chamberlain.— I have bought it for $14 per ton, guaranteed to contain 14 per cent. phosphoric acid.

Question.— Would it pay to use commercial fertilizers on oats?

Mr. Smith.— That would depend. If the land is poor and lacking in vegetable matter, probably one would not get the money back he paid for the fertilizer.

Question.— Does the continued use of commercial fertilizers injure the land?

Mr. Smith.— A pound of nitrogen or one of potash, or of phosphoric acid, is the same, no matter from what source it comes. As a rule, the farmer applies just about the same quantity of plant food in a fertilizer on an acre as he would in one load of manure which he applies near the hill. It gives the plant a start, but does but little further good. If this system is continued without returning vegetable matter to the soil, meanwhile removing crops, it will injure the soil by making it less productive each year.

Question.— What is the best way to apply commercial fertilizers on corn ground?

A Farmer.— I put on 200 pounds to the acre, and never got any benefit.

Another Farmer.— I got the best results when drilling the fertilizer in.

Mr. Smith.— There would not be enough of the fertilizer to do much good. Would you expect to derive much benefit from only two loads of barn manure spread over an acre of land? Yet, there was no more plant food in that fertilizer than in two loads of such manure. You will have to apply more fertilizer than 200 pounds per acre to get much benefit.

Question.— Do potato tops add potash enough to the soil to benefit strawberries, which follow?

Mr. Rice.— The potato vine is a ravenous feeder. There is some plant food in them. If they are burned, the nitrogen is lost, but the mineral elements go back to the soil.

Mr. Smith.— There is $1.60 worth of nitrogen, potash and phosphoric acid in one ton of potato vines, which, if they are plowed under and left to rot, will be mostly saved.

Mr. Rice.— A ton of potatoes has $1.20 worth of fertility in them, not as much as the vines contain.

Mr. Smith.— Nearly all the potato, aside from the water in it, is starch, which contains no fertility at all. You could not grow a potato in a ton of starch.

Question.— Can cow peas be successfully grown as a fertilizer in a cold section?

Mr. Smith.— I know of no reason why they can't. You are not in a very frosty country? We grow them in Geneva without any trouble, and, it seems to me, you ought to grow them. They are a bean, not a pea, and take nitrogen from the air; therefore, they are a good crop to turn under, both to furnish nitrogen and humus. But in the north, one must wait till all danger of late spring frosts has passed. We grew some of them and put them into the silo with the corn. The live-stock ate the ensilage all right, but did not seem to relish the peas when fed alone. We also grew some of the soja beans, but they also went into the silo with the beans and corn. Any of these crops, when turned under, provide humus, which holds moisture, to liberate plant food, and thus helps the plant to grow. Even straw manure, which we do not consider of much value, when turned under by the plow, has a value in stimulating changes that release plant food in the soil.

A Farmer.— Will straw, plowed under, take nitrogen from the air?

Mr. Smith.— No; but when it decays it holds moisture, which makes plant food already in the soil available for the use of the plant.

Question.— What is cottonseed meal worth per hundred pounds? Where can it be obtained? Would it pay to use it to grow potatoes? If so, how would you apply it?

Mr. Rice.— I don't know what the price of cottonseed meal is; probably about $24 per ton. It is rich in nitrogen. It may be mixed with South Carolina rock, and drilled in. It works through the drill very nicely. If phosphoric acid and nitrogen are needed, the mixture would be a good one. If only nitrogen is wanted, nitrate of soda and dried blood, at present prices, might be acceptable, but cottonseed meal would rank next.

Question.— In what form should phosphoric acid and potash be applied on the land?

Mr. Smith.— Phosphoric acid is most cheaply obtained in dissolved South Carolina rock; potash, in the muriate or sulphate. Sulphate is better for fruit. It has not been proved that it is any better for potatoes. Wood ashes contain potash. It is their most valuable constituent. They also contain a small per cent. of phosphoric acid; the residue is lime. If the ashes contain five per cent. of potash and one per cent. phosphoric acid, and are dry, clean and pure, they make a good fertilizer.

Question.— How shall we know what fertilizer our soils most need?

Mr. Smith.— By observing the plant. If it makes a large growth of straw and falls down, there is an over-supply of nitrogen; if the growth is feeble, a lack of it; if the leaf is lacking in vigor and color, or the fruit lacks in color or sugar, there is a want of potash; if the fruit falls prematurely or does not perfect, there is a lack of phosphoric acid.

Question.— Will it pay to fertilize corn with phosphate when planting it?

Mr. Woodward.— I have made commercial fertilizers pay on potatoes, but never on corn. I keep a good many sheep and get manure enough. We apply our manure on a clover sod every day during the winter, which we will turn down for corn. The next year I plant potatoes on the same land, and I find I can make a fertilizer pay in that way. I have put these fertilizers on corn. On wheat and other grain crops I have never made them pay.

Question.— Can anything be added to muck to make it a paying fertilizer?

Prof. Cavanaugh.— Some muck is rich in nitrogen. I have known samples of it to contain as much as 2.5 per cent. nitrogen. It is the remains of vegetable decay, but, if this is dry, its nitrogen value is lessened. Our best onion soils are muck, but they may be sour. Add lime, then add potash and phosphoric acid to such muck soils.

To Mr. Smith.— What formula of fertilizer, other than barn manure, do you use for top-dressing the alfalfa field on the Geneva Station farm?

Answer.— As a rule, the field is top-dressed with fine barn manure once in two years. If we do not have the manure, a commercial fertilizer, made up of 100 pounds of dried blood, 100 pounds nitrate of soda, 100 pounds muriate of potash, and 200 pounds dissolved South Carolina rock per acre, is substituted.

Question.— Is the phosphoric acid in bone more valuable than in South Carolina rock?

Mr. Chapman.— The chemist, or plant, finds no difference. It is cheaper when bought in South Carolina rock.

Question.— Would you plow under manure for corn?

Mr. Witter.— My practice is to apply manure to the ground in winter, and plow it under in the spring before planting corn. Decaying vegetable matter in the soil will raise its temperature and help the corn to grow.

Question.— When lime is used to correct acidity in the soil, will it answer just as well to scatter it in the gutters behind the cows and so first use it as an absorbent, as to apply it directly to the land?

Mr. Smith.— Most assuredly not. Lime would not only release all the nitrogen in the manure, but would burn up the humus. Do not use either ashes or lime in the stables or the poultry-house. Either use land plaster or dissolved South Carolina or Florida rock.

SOME VETERINARY INQUIRIES.

Question.— What is the cause of winter fouls in cows?

Mr. Stevens.— The trouble referred to must be in the nature of the foot rot. It is a contagious disease, and great care should be taken to avoid infection. Burning it out with oil of vitriol is sometimes practiced as a remedy.

Prof. Hall.— Dr. Smead recommends cleaning it out and applying butter of antimony.

Question.— What can you do for garget in cows?

Mr. Stevens.— This is a trouble which comes from various causes. It may be hereditary, or it may be caused by accident, but, in either case, the trouble is in the blood and must be doctored accordingly. I use for this purpose doses of about one-half ounce of saltpetre in the feed, and give a little linseed oil. Bathe the affected parts with water as hot as you can bear to the back of the hand and follow with fomentation or poultice of hot wheat bran. Give good care and be careful in milking not to injure the affected part.

Question.— Can you give a remedy for the ox-warble or larvæ of the ox-bot fly?

Mr. Banks (Assistant State Entomologist, Albany).— The application, carefully made of kerosene, or of mercurial ointment on the spot under which the bot or grub is lying, will prove an almost certain remedy for this pest.

Question.— Is there a permanent cure for garget in cows?

Dr. Smead.— Some cows are born gargety. They cannot be cured. As a rule, if treatment is resorted to before the udder has become inflamed, the disease can be removed. Bathing the udder with hot water and a dose of aconite and poke root given internally, are the best remedies I know.

Question.— What is good for a horse's foot where the hoof has become hard and feverish?

Dr. Smead.— When horses are allowed to stand on a hard floor, their feet sometimes become feverish. Wrap cloths around the feet and saturate them with hot water. A mixture made of one ounce oil of tar, one of turpentine, and two of raw linseed oil, rubbed on at the summit of the hoof, is a good remedy.

Question.— Are tuberculous germs located elsewhere in the animal except in the lungs?

Dr. Smead.— Yes. Tuberculosis may be present in other organs of the animal than the lungs. Tuberculosis of the lungs is known as consumption in human beings, but ofttimes tuberculous germs are found in other organs, not only in the animal but in mankind. It is quite probable that there is not a person present but has tubercles somewhere. This has been the condition since man came on earth; yet, within the last 50 years consumption has decreased 50 per cent. You may go out and kill any cow you have, and if you don't find tubercles in the body, if a good post-mortem is held, you will have what is not often found, a perfectly healthy animal.

Among the post-mortems made at the Bellevue Hospital, New York, 92 per cent. were found tuberculous, and yet but few of them died of consumption. I should not use the milk from an unhealthy cow, nor from one which had been tested with tuberculin, if I knew it. If one has a cow which shows disease, he should quarantine it from the herd, give it good care and feed it properly. If the disease develops, and you are sure that tuberculosis is present, slaughter the animal, but don't use tuberculin on a healthy animal. It cannot be depended upon, only in the hands of an expert. Any foreign substance, as a rule, if injected into an animal, will raise the temperature of the body. John Gould of Ohio, recently said that he witnessed the slaughter of

24 cows which had been tested with tuberculin and condemned, but the post-mortem failed to find a tubercle. It is wholly unreliable and in the near future will have to go.

The consumption of milk in New York city has more than doubled during the last 10 years, yet the death rate from consumption has decreased 7 per cent., while the number of inhabitants have increased nearly 1,000,000. The same increase in proportion of inhabitants and the consumption of milk is recorded in other cities of the State, and the same decrease of death by consumption, showing that this tuberculosis talk is a humbug, gotten up by a few men who want a pull.

Mr. Stevens.— The honest farmers in this State ought to rise up and condemn this, the greatest humbug ever sprung on them. Massachusetts has refused an appropriation for continuing the test, having found it wholly unreliable.

[The New York law as it now stands should be perfectly satisfactory to farmers, having been revised during session of the Legislature, 1900–01.]

Question.— Do young pigs have tuberculosis, and what are the symptoms of hog cholera?

Dr. Smead.— Possibly they may have tuberculosis, but, as a rule, they have rheumatism. There are but few cases of hog cholera. Rheumatism is caused by dampness or improper feeding. If you hear that your neighbor's hogs have cholera, don't go near them, for you may carry the germs of the disease in your clothing or on your boots. It is caused by a germ, as is smallpox or other contagious diseases which afflict the human family.

Question.— Is tuberculosis among cattle on the increase?

Dr. Smead.— No. Tuberculosis, both in mankind and animals has been on the decrease during the last 25 years. People are learning to better clothe, better feed and better care for themselves. They are also learning to better care for and better feed their animals. Sunlight, pure air, good food and cleanliness will kill tuberculous germs. The disease is growing less everywhere.

A Farmer.— If that is so, how do you account for its appearance in Governor Morton's herd?

Dr. Smead.— Well, oftentimes things are overdone, and, as a rule, they are overdone in this tuberculosis business. Governor Morton's cows had the disease, but a number of them had it in a harmless way. Many tubercles were incysted and would never have done any harm; and I am going to say that, in my belief, there is not a man here but has tubercles present somewhere in his system, but he will never die of the disease. If you have a cow that has a cough or scours, watch her. If the disease increases, quarantine her. If the old cow eats well and chews her cud, don't go near her with tuberculin. Let her alone. She will come out all right.

Question.— How can a man or animal avoid dying of tuberculosis?

Mr. Woodward.— By giving good sanitary conditions. We want to give the animals pure foods, pure air and plenty of sunlight. Then they will have plenty of rich red blood. I once had tuberculosis, so the doctors said, and was told I must go South or I would die. But I did neither. I simply began studying sanitary laws and obeying them, and am here yet, with no tuberculosis about me.

Mr. Smith.— When my father was 30 years old, it was said he had consumption and could not live long. He began following Mr. Woodward's prescription and is alive now at 87 years of age.

Question.— Is milk from a cow afflicted with tuberculosis, fit for the manufacture of butter or cheese?

Mr. Smith.— The milk of a cow afflicted with tuberculosis of the udder is not suitable for use in any kind of human or animal food. When cheese or butter is made from ordinary milk the germ of disease is not destroyed. A heat of about 184° is necessary to destroy such a germ.

A Farmer.— How shall we know when a cow has tuberculosis?

Mr. Smith.— Any honest farmer who will read, and carefully watch the condition of his herd will easily detect it when the disease has reached a stage to be injurious.

Question.— What are the symptoms of tuberculosis?

Mr. Smith.— It is hard to answer the question. If the tubercles are in the lungs, there will be difficulty with the breathing, such as coughing and wheezing. If they are in the bowels, there will be scours. If there is a run-down condition in the animal you cannot account for, the best thing to do is to quarantine it from the herd. Care for it well and await results.

To Mr. Gould.— Will it affect an old animal more than a young one?

Answer.— I don't know anything about tuberculosis. I have to come to New York to find out about it. I heard a veterinarian say that a young animal might be cured of the disease, because the tubercles would become incysted and healed, while in an old one they would not.

Question.— Are Jersey cattle more susceptible to tuberculosis than are other dairy breeds?

Mr. Van Alstyne.— Most emphatically, no. The report that the Jersey is more susceptible to the disease came from the fact that the first herds tested and found diseased were Jerseys. If other herds had been tested as widely, no doubt just as many animals would have been found diseased.

Question.— What is the cure or preventive for garget in cows?

Mr. Van Alstyne.— The best cure is prevention. If, however, the udder become gargety, give the cow a dose of Epsom salts and bathe the udder with water as hot as you can bear your hand in. At the same time work the udder and use every effort to draw the milk. A piece of fat salt pork bound on the udder often reduces the inflammation. The disease is contagious. Therefore, the cow having it should be the last of the herd milked, or else the milker should thoroughly wash his hands before milking a sound cow.

Mr. Fenner.— I have been troubled with garget in my herds more or less during 60 years, and have invariably found a poultice made of clay, as soft as mortar, and bound on the udder, a sure cure.

Question.— What is the best remedy or cure for scours in young calves?

Mr. Smith.— Laudanum and the white of egg, is said to be a preventive; but I have not the proportionate ingredients tables with me.

Question.— Does milk fever affect the cow except in the udder, and will injections of something into the udder, cure it?

Mr. Gould.— "An injection of half a pint of 1 per cent. iodide of potassium, 1 per cent. strength, into each teat. In the mouth we inject half a pint of whisky, one and one-half pounds of salts, two ounces of ginger, one-half drachm of nux vomica, as a drench. The treatment was repeated once in four hours." The foregoing is a prescription given out by the State veterinarian of Pennsylvania. Our veterinarian has tried the remedy, and succeeded in saving three cows out of five, that were ill with the disease.

Question.— What can be done for a horse that is stiff in his knees? Is there any remedy?

Dr. Curryer.— I do not know that there is any permanent remedy. An application of angle-worm oil well applied may help him.

Question.— Is there any better remedy for garget than turpentine and lard?

A Farmer.— Liquid extract of poke root. I have used it successfully. Aconite is good; so is saltpetre.

Mr. Chapman.— I have used poke root very successfully. If the udder is caked, the inflammation may be reduced by bathing it in hot water and anointing it with vaseline and lard.

Question.— I have a horse 18 years old. He lately began to stagger with his fore feet. Is this an evidence of disease? If so what, and what is the remedy.

Dr. Smead.— Does he do this all the time, or by "spells"?

The Questioner.— By spells, and it seems to be inability.

Dr. Smead.— It is a paralytic trouble; there is no help for him whatever.

Question.— Do cattle always have a cough with tuberculosis, and does New York State stand a part of loss when such cattle are killed?

Dr. Smead.— No; cattle do not always have a cough when afflicted with tuberculosis. When they have a cough it may come from an affection of the bronchial tubes. A bronchial affection does not indicate the disease, but scours do. As to who loses the animal, if destroyed, is as yet to be determined. There is yet no appropriation, nor should there be. If a man has a tuberculous animal, he should kill it. He ought not to have pay for it any more than for any other diseased farm animal that dies and has to be slaughtered because of disease.

Question.— I have a horse with a dormant digestion. Sometimes he is sensitive to touch on the flanks, especially when idle for a time?

Mr. Ward.— Do not allow the horse to stand idle. Hitch him and drive him a little every day, even if you have to do it after dark. If you can't do that, put him loose in a box stall and give him an opportunity to stir about. If the horse becomes ailing give him a tonic made of ground ginger, powdered gentian and sulphate of iron; a tablespoonful once a day.

Question.— What is best to use on cuts and bruises, etc., on horses?

Mr. Ward.— If the wound is caused by a bruise, apply arnica liberally. If it is from a cut, use some one of the carbolic sheep dips, using one part to one hundred parts of water. Mix three quarts vaseline and one-quarter sheep dip for a salve and apply to a cut. It will cleanse the wound thoroughly, and at the same time, heal it. But, give the horse exercise. If any one of us were kept constantly in the house and fed all that we could eat and digest, we would have torpid livers and be troubled with indigestion.

Question.—What causes the white, chalky scab around the eyes of cattle, and what is the remedy?

Dr. Smead.— Is it only about the eyes?

A Farmer.— It is also on the sides.

Dr. Smead.— It is a ring worm, swab it with tincture of iodine. The disease is contagious and may be conveyed to the whole herd; so it is best to anoint the faces and shoulders of each animal in the herd, with the tincture of iodine if you have a case of the ring worm in your herd.

In answer to the question: "What causes corns on horses' feet," Dr. Smead named them, saying, the farmer often caused them by having the horses' shoes on too long, but, as a rule, corns are caused by bad shoeing. Sometimes by burning or cutting out of the corns, relief may be obtained for a time, but they will grow again. Other questions relating to diseases of the bones of horses were also asked and answered by the doctor, who showed by way of illustration, some of the bones of the horse's foot and leg, on which were seen the effects of ossification.

To Dr. Smead.— What is the best preventive of milk fever?

Answer.— Give three-fourths of a pound of salts to a Jersey or Jersey grade, weighing 900 pounds, beginning two weeks before the calf is dropped, and repeating it every five days. To a Holstein weighing 1,000 or more pounds, give a pound of the salts, but mix three-fourths of a tablespoonful of powdered gentian in the salts. This will keep the bowels open and regular, and prevent the appearance of the disease.

Question.— Is there any cure for cholera in calves?

Dr. Smead.— If a calf has absorbed the poison that causes the disease, previous to its birth, there is no help for it. If not, olive oil beaten with the white of egg, with equal parts of spirits of camphor, peppermint essence and laudanum will be a very good remedy; a teaspoonful every half hour, may prevent the appearance of the disease. Prevention is the best cure.

Question.— Give a liniment to take out soreness in a horse's legs, caused by spavin?

Dr. Smead.— Tincture of opium, tincture of arnica, spirits of camphor, mixed equally, makes a good liniment to relieve pain caused by spavin.

Question.— What liniment will limber, or take the soreness out of a sprain so that the horse may be worked?

Dr. Hatch.— There is no liniment which will take the soreness all out of a sprain, but it may be relieved by drawing it somewhat to the surface.

Question.— What will kill lice on cattle?

Mr. Smith.— Anything that will stop the lice from breathing. Plaster, road dust or grease will kill them. They breathe through holes in their sides, and anything that will close them, kills the lice.

Question.— Give a lotion to prevent chapped teats on cows.

Dr. Smead.— Carbolized vaseline. Two ounces of vaseline mixed with a tablespoonful of carbolic acid, perhaps, is as good as any application for chapped teats.

Question.— What will cure white scours in calves?

Dr. Smead.— The cause is often overfeeding of too cold milk. Watch the calves and know just how much to feed them. Keep all vessels clean that they are fed in. It is a good plan to mix lime water with milk when calves have the scours. Albumen in the form of an egg is good for the calf. A little laudanum will help to alleviate them when they are in pain. In advanced stages, I should give a little oil — castor or linseed.

Question.— What are the symptoms of black leg in cattle?

Mr. Witter.— Anthrax is the proper name. The animals usually first become lame in one quarter. It invariably kills, and is very contagious.

Question.— What is the treatment of a cow with large and inflamed knee?

Dr. Smead.— I would puncture it to draw off the fluid, then bathe with tincture of arnica. This is the treatment, if the trouble is not chronic.

Question.— Can a poll evil be cured, and how?

Dr. Hatch.— Poll evil, if treated in the first stage, may be prevented by the use of a blister. If it is allowed to progress, nothing but a surgical operation will cure it. A tincture of Spanish flies, one ounce, croton oil, ten drops, will produce a blister which, if early applied, will prevent the disease developing.

Question.— What causes the excrement of a cow to be thin when she has two feeds of straw and hay?

Mr. Van Wagenen.— I do not know, unless it comes from indigestion, caused by a cow's eating too much of those foods to disarrange her digestion and bowels. It is another question for a veterinarian.

Question.— Is there such a thing as "black teeth" in pigs?

Dr. Smead.— Yes. If you will open a pig's mouth you will find black teeth. As a rule, they are black when the pigs are farrowed; but there is no such pig disease as black teeth. Sometimes the teeth become blackened by internal parasites. When the pig is well nourished, black teeth do not appear.

ABOUT HORSES.

Question.— Is wheat straw better than oat straw to feed a horse when it is being fed oats?

Dr. Smead.— I may run up against a snag when I answer that question, because I am going to say that wheat straw is the poorest food ever given to an animal. Oat straw's nutritive ratio is 1 to 33; wheat straw 1 to 64. But there are many farmers who say they get best results from the wheat straw. As a rule, this is caused by the clover or other grasses which are cut when the wheat is reaped, and which is left in the straw.

Question.— Ought horses to be watered in the morning before feeding, or after?

Dr. Smead.— The best time to water a horse is when he wants to drink. Some horses will drink in the morning before they will eat; some will not. It is another case of individuality. One horse will drink more often, another less. The only way is to offer water to him. If he wants to drink he will do it, and if the horse has been working, offer him a little water occasionally, but don't take him to a trough and allow him to drink all he will take, as his stomach will not hold more than three gallons at a time.

Question.— Does it pay to grind feed for horses?

Dr. Curryer.— It would depend on the age of the horse. If he is old and his teeth are poor, have the grain ground. A good way is to put a few lumps of rock salt in the grain box and spread the grain over them, so that the horse will have to nose around after it. He will take a little every time he eats. Feed him from a box near the floor, not too high up. No; I do not think that it will pay, as a rule, to grind grain for the horse.

Question.— Have you ever tried the hitching of a horse's head to his tail?

Dr. Curryer.— Yes, sir. It is one of the most effective means I know to cure a horse from running away. When he makes an effort to run away he will stop in about 15 seconds, because he will find he cannot get away.

Question.— Is it advisable to give a young colt all the hay he can eat and all the water he will drink?

Mr. Chapman.— I think it advisable to get a good growth on a colt during the first three years, but I should not get him fat. A colt tied to a hay mow and allowed to eat all he will, as a rule, will be ruined. A colt, to make muscle, ought to have a balanced ration. Enough protein to balance the fat, which he cannot get from timothy or corn. Young horses grow rapidly on green corn sown so thickly as not to develop ears, however.

Question.— Do horses have wolf teeth? If so, do they cause blindness?

Dr. Curryer.— They are supernumerary teeth. Let them alone; they never have, nor never will, cause blindness. We have had as many as 500 horses, but we never pulled a so-called wolf tooth yet. Some veterinarians say, "Take them out"; but it always costs a quarter or more each to do it; besides, the removal of them always injures the horse somewhat, as it affects its head. If a tooth is so deformed as to cause the bit to hurt the mouth, perhaps it were better to take it out. Possibly there may be an abnormally developed wolf tooth in a horse's mouth, but I should not take it out unless I was satisfied it was causing mischief.

Dr. Smead.— Wolf teeth do not cause blindness. They are abnormal, and if they disturb the natural condition of the mouth, they will cause the eyes to become watery; but it will not be necessary to take them out unless they disturb the natural functions of the mouth. If the colt's eyes become watery, wash them with warm water with 10 or 15 drops of camphor in it.

Question.— Is there such a disease as "moon eye" in a horse?

Dr. Curryer.— Yes; it has a scientific name, but it is not necessary to give it here, as the question using the common name is better understood by the farmers. It causes a watery or milky appearance of the eye, and, as a rule, eventually ends in blindness. It is just the same as inflammation of the eye, and comes on by degrees. I know of no cure for it.

Question.— Which is best for horses, whole or cut hay?

Dr. Smead.— There will be no advantage in cutting hay for a horse, where it is fed alone.

Question.— I am feeding ensilage and four quarts of oats, with wheat and oat straw; what shall I add?

Dr. Curryer.— I should add a little oil meal. A little bran added will also be beneficial.

Question.— Will a few potatoes fed to a horse, three or four times a day, with other foods, be injurious?

Dr. Smead.— How "few?" A few potatoes, say, two quarts, once a day, will not injure a horse, provided he relishes them. The trouble will come, if any, from the raw starch in the potatoes, which is quite indigestible. The parings are better than the whole potato, as there is an element in the potato eye which is a cathartic, and so acts as a vermifuge that destroys pin worm in the horse. As many as four quarts of the parings may be fed, but do it the first thing in the morning, before any other food is given. But one must study individuality; one horse will not assimilate and digest as much as will another. One horse will eat four quarts of potatoes three times a day, while another will not eat them at all.

Question.— What is the best grain food for a horse?

Dr. Curryer.— The best single grain for a horse is oats. For a mixture, oats and corn is best.

Question.— Which is the best to feed to horses, oat or wheat straw?

Mr. Gould.— The oat straw is the better of the two.

Mr. Smith.— When oats are cut while quite green, they make about as good a food as does common timothy hay.

Question.— What class of horses are wanted mostly for foreign markets?

Dr. Smead.— Germany and England want cavalry horses. England is also asking us for fine driving horses, which now mostly come from the West. French coach and Cleveland bay are being bought, as well as are the large draft horses.

Question.— Is there anything in sight to indicate that the production of high-class road and coach horses will be overdone?

Mr. Smith.— I do not believe there is. There is a demand in the market for good horses, and none at all for poor ones. You have the example of Mr. Stevens here, who has very fine horses, which he is rearing and selling at a profit.

Dr. Smead.— We have sent 100,000 horses to Great Britain since the breaking out of the Boer War, and Germany has sent 30 experts here to buy cavalry horses. Then, if you want a fine horse from the Buffalo market, you will have to put your hand deeply in your pocket if you get him; and it seems to me a very foolish plan for the New York farmers not to breed and rear horses for these foreign markets, when they very well know they could get good paying prices for them. But the trouble is, the average farmer waits till he has some old ring-boned, spavined, crippled mare, and then breeds her to a no-purpose sire. He never asks the market, but raises a colt to suit his own tastes. When he has it reared, he must keep it or sell it at a losing price, as no one wants it for foreign or city markets.

Question.— When you are feeding a horse 12 quarts of oats per day, is hay better than straw to be given with them?

Dr. Smead.— It would depend wholly on the hay or straw. Oat straw would be better than wheat, and mixed hay better than timothy. At night, the horse should be given more hay than at noon or morning. But it would depend very much on the individuality of the horse. One will require more oats or hay than will another. Do not feed every horse or other animal just the same quantity of hay or grain.

Question.— What is the best maintenance ration for a horse when hay is high?

Dr. Smead.— It depends on what the horse is doing. Grain is cheaper than hay at present prices, as a much larger percentage of it is digestible. If the animal is working, the ration should contain more of the protein.

Question.— Is gluten a suitable food for a horse, with other grain? How much should be fed to a work horse?

Mr. Witter.— It is, but it should be fed in moderation. All animals do better on a variety of foods. Gluten is rich in the muscle and blood food. I have fed four pounds daily, with good results.

Mr. Gould.— I have fed one-third oats and two-thirds gluten to work horses and have never had them do better. I believe it is one of the best winter foods for horses also.

MILK AND SOME OF ITS PRODUCTS.

Question.— What causes mottled or red spots in cheese?

Mr. Richardson.— So far, there has not been found a man who can tell. Dr. Jordan and Prof. Harding of Geneva, have been experimenting with the problem a long time. They have discovered the germ that causes the spots and are able to grow it and to inoculate the milk with it. That is as far as they have gone. They have not discovered any cure so far. I have sent samples to the Station several times and much time and money have been spent in investigating them, but I have received no further information than I have given. We have gone so far as to rebuild a factory almost completely, and sent one of our best men, W. W. Hall, to the factory to make the cheese, and yet the spots came into the cheese. We also went to the extent of going to the patrons' dairies and enforcing the law, by compelling them to make everything clean in and about the barns, stables, water and everything else connected with the dairy. At the end of several weeks we were able to make a cheese that went to New York and sold for the full price of best cheese. This was a case in western New York. Some of the patrons said: "This is my farm and I purpose to run it as I have a mind. I'll do nothing of the kind."

We said: "Very well. You have a right to run your farm as you like, but you will have to keep your milk out of this factory." Results as before stated, a disappearance of the red spots. Mr. Richardson also mentioned a case where red spots came into the cheese of a certain factory. After thorough investigation, it was found that five cows in one herd persisted in drinking from a pool of stagnant water in the pasture. A fence was put around that pool and the cows forced to drink from a running stream with the remainder of the dairy. The result was a disappearance of the spots.

Mr. Smith.— They are caused by a germ. Prof. Harding has not only discovered it, but cultivates it. I have made cheese from milk inoculated with the germ he cultivates, which was as red as blood, and I found that it impregnated the curd most after it had been cut. We know what the germ is, but not where it comes from; but are hoping to ascertain the source during the year.

Question.— Does it injure the cheese for food?

Mr. Smith.— Not at all; only in its appearance, which gives the buyer a chance to drop the price.

Question.— What produces sweet or fruity flavor in cheese?

Prof. Harding.— The Lord only knows; I don't. We have collected 30 samples of cheese within the last year that gave 30 different smells. So that fruity flavor is produced by a multitude of causes. We have corresponded with a number of persons and have made thorough search for these causes, but so far have failed. Up to this time there have been no definite causes discovered. The germs that cause these flavors get into milk and produce the same effect somewhat as does yeast in bread. We are whacking away, however, and have made some progress the last year, and are in hopes that we will be able sometime to give the causes and a cure for them.

Mr. Smith said that the yeast or germs have got into the room in his department at the Station where he does dairy work, and, despite all the efforts they have made to keep the room perfectly clean, he is unable to make a cheese there that does not have this flavor. The room will have to be disinfected with some preparation that will eradicate these germs before cheese free from this flavor can again be made there.

Question.— What quantity of moisture can be left in cheese and have a good keeping quality?

Mr. Richardson.— We want a silky-textured cheese. Retain for a home-trade cheese all the moisture that the cheese will assimilate and make it soft and mellow. More of it will decrease the keeping value of the cheese. I want a cheese just moist enough so that when I try it and break the plug it will show no free moisture; yet, when rubbed between the thumb and finger, it will be soft, mellow and silky.

Question.— When do skippers get into cheese — in the vat, in the press or in the curing-room?

Mr. Richardson.— I have watched the skippers often, but I suppose the question relates to their origin. They come from flies which lay their eggs on the cheese. If it is smooth and the bandage is tight and there are no holes where they can get in, there will be none of them. As a rule, they get in in the curing-room.

Alson Cook.— Sometimes the edges of the cheese become crackled in turning and, therefore, crumble slightly. This gives the flies an opportunity to get their eggs inside the cheese.

Question.— Shall we patronize the creamery?

Mr. Smith.— Every man must decide that for himself. If you want the most money from the dairy, you will patronize the creamery. When you have 30 or 40 women in a neighborhood making butter, you have just as many varieties of butter. So there is no question about the value of the creamery. Beside producing a uniform quality of butter, instead of 30 or 40 qualities and colors, it removes a large amount of work and care from the farmer's wife.

Question.— Which will be most profitable, financially, the cheese factory or creamery?

Mr. Smith.— It is pretty hard to say that one system is better than another. The trouble is that, when butter brings the highest prices, the farmers all want to drop cheese and go to making butter. Bye-and-bye, butter drops in price and cheese goes up; then they drop butter and rush after cheese. As a rule, those who "stick" to the one or the other come out best at the end of the season.

Question.— Would it be safe for a patron of a factory, under the present laws of the State, to put his milk into a factory, if his herd are great milkers?

Mr. Smith.— Yes, sir. We have traveled the State from end to end and have found not more than half a dozen small herds that gave milk below three per cent. fat. Those were Holsteins that had been bred for a large flow of milk instead of milk of good quality. The average per cent. of fat in the dairies of the State is three and eight-tenths per cent. The old system of pooling milk simply puts a premium on poor milk; while the Babcock places a premium on good milk, because it awards to every man that which belongs to him. No more; no less.

Question.— How many pounds of milk is necessary for one pound of butter?

Mr. Smith.— Every pound of butter fat in the milk, if the work is well done, allowing 15 per cent. moisture, will make a pound and two ounces of butter; that is, a pound of three per cent. milk will make three pounds and six ounces of butter; four per cent., four pounds and eight ounces; and so on, according to the fat per cent. in the milk. Remember, the milk must be perfectly creamed and properly churned.

Question.— How much three per cent. milk is required to make one pound of butter?

Mr. Smith.— If the work is well done, it will require 28 pounds of three per cent. milk, including 15 per cent. moisture, for one pound of butter.

Question.— What is the cause of white specks in butter when it is well cared for and in other ways is all right?

Mr. Smith.— If everything is right, there will be no white specks. As a rule, these specks are caused by bits of dried cream or bits of casein, where the cream has been raised in shallow pans, that adhered to the cream.

Question.— How much cream can be taken off four and one-half per cent. butter fat, according to the Babcock test?

Mr. Smith.— Four and one-half per cent. cream means four and one-half pounds of butter fat in 100 pounds of milk; nothing more. When we separate cream from milk we usually remove about one-sixth of the body of the milk. In other words, we take out about 17 pounds from 100 pounds of milk, but we can reduce it to 12 pounds or run 50 per cent. cream.

Question.— Which is the best for butter-making, the separator or the creamery cans?

Mr. Smith.— The separator will skim down to fifteen-hundredths of one per cent. of fat. As a rule, the submerged cans will not skim lower than one-half of one per cent. The separator not only skims closer, but gets your cream more quickly and gives you a less bulk to handle. There is no other method nearly as profitable for the dairyman. Beside the gain in butter, the quality of the skim milk from the separator is much better, because it is purer and cleaner than that from any other creaming system.

Question.— Is a creamery a good thing for a community?

Mr. Chamberlain.— A creamery ought to be a benefit to any community, if it is run properly.

Mr. Smith.— In many parts of the West the creamery is an established institution, nearly all the finest butter in the market being made there. The same is also true in many localities in New York.

Mr. Dawley.— There is no doubt about the benefit of the creamery if for only one result. It insures a uniform product every day it is operated. If the 30 patrons of a creamery each made butter at home there would be 30 different grades of butter — some extra good, some very good, some medium and some bad. Another point: It takes off a great burden from the women's department of the house. But, if you are going to establish a creamery, agree to take in the milk and pay for it on the decision of the Babcock test, and arrange it so as to have the creamery run every day in the year.

Question.— Is it a fact that more butter can be made by the use of the separator than by the old way?

Mr. Smith.— It is a most assured fact, because it skims more cream out of the milk than does any other creaming device.

Question.— Can all the butter fat be got out of milk by diluting it with water?

Mr. Smith.— No; there is no method by which all the fat in milk can be extracted. The centrifugal separator skims down to within five-hundredths of one per cent. The deep setting, or what is known as the gravity system, ranks next; and, when the cows are fresh in milk, will skim, if the work is well done, to within thirty-five-hundredths of one per cent. of fat. The diluted system is the poorest of all skimming devices. It is not as good as the old-fashioned shallow pans. Then, too, the skimmed milk having been diluted sometimes with poor water, is very much impaired, while the butter made from the cream is of poor quality.

Question.— What causes butter to taste strong after it is two or three days old, utensils perfectly clean, food changed?

Mr. Smith.— There is something wrong somewhere; either the milker or the butter-maker is not clean. If all the utensils used are clean, the milker is clean and the butter-maker is clean, the butter will not become strong. But very few butter-makers know what it means to say "clean utensils." They should be thoroughly sterilized every day. The simple methods of scalding and rinsing of a pail or milk can will not answer. They should be steamed or washed in scalding water to kill the bacteria which get into the seams and other hiding places. In this case something of that sort is making the trouble. The feed of the animal has nothing to do with it.

A Farmer.— Would not poor ensilage cause it?

Mr. Smith.— Possibly; but I think not much trouble would come from that source. It has been proved that none of those germs can go through the stomach of the cow and thence into her udder. Usually these germs come either from the stable or from unclean milk utensils. As a rule, a food that imparts some particular flavor to milk will not affect the butter made from it. There is one bacteria, however, which grows below a temperature of 40 degrees which causes milk to become bitter. That flavor will follow and appear in the butter. This bacteria does not grow in a temperature above 40 degrees. Do not keep cream in a temperature below 50 to 55 degrees if you would avoid the appearance of this bacteria.

Question.— Will sterilized milk become sour if left uncovered in the cellar? If so, why?

Prof. Harding.— The word "sterilized" is a much abused one. Probably "scalded milk" is what is meant. To sterilize milk thoroughly, and thus kill all the germs in it, it will have to be boiled three or four hours; so that milk only scalded does not lose all its bacteria plant life.

Mr. Smith.— I have heated milk up to 190 degrees and held it there two hours, thinking I had killed all the germs; but Prof. Harding succeeded in finding live bacteria in it, nevertheless.

Question.— Why does milk sometimes become thick and yet be perfectly sweet?

Prof. Harding.— It is caused by a bacteria which grows in milk in certain conditions. The preventive is the thoroughly steaming or scalding of all dairy utensils and the thorough cooling of the milk directly after it has been drawn from the cow.

Question.— Do you get bad effects in milk, especially in the flavor by feeding bran mixed with dishwater where soap has been used?

Mr. Smith.— I never feed any such mixture and would not; I would be afraid of the soap.

Question.— What do you think of a gravity separator?

Mr. Smith.— I think but little of it. It is not as good as any other device I know, except under one condition, which is, when a man does not have a room of proper .temperature, or no ice, the aquatic cans will help him out in part; but it does not get as much fat, while it makes a soft, loose-textured butter. Another point, the skim milk is not nearly as good to feed. A calf or pig ought not to be forced to drink twice the bulk to get the same quantity of milk. Then, too, butter made from such cream will not keep as long as will that made in any other way; or, rather, from cream raised by any other method. But why call it a separator when it is not one at all, and why pay $10 for a double can, one set inside the other — with a thermometer and faucet inserted in the outer one, when you can go to a tinner and get them for $3.

Question.— What temperature is best in which to separate milk?

Mr. Smith.— If you use the De Laval separator, a temperature of 70 degrees is the right one. If the United States machine is used, have the milk at 80 degrees.

Question.— Do the condensaries in eastern New York pay for milk on the Babcock test basis?

Mr. Smith.— No; the condensaries do not. All milk is pooled, but it must test 3.5 per cent. fat.

Question.— What is the feeding value of separator skim milk?

Mr. Smith.— It depends on how it is utilized. As a rule, it is worth 15 cents per hundred. Some farmers, who are feeding it to pigs, when wheat middlings are fed with it, get 25 cents, and I have known cases where even 30 cents was obtained; but the farmer will not average much above 10 cents. Skim milk contains all the casein, sugar and albumen — all the solids except the fat.

Question.— What would be the cost of constructing a subearth duct curing-room at our cheese factory? What would be the profits to the patrons?

Mr. Smith.— Prof. Robertson of Canada, said at the meeting of the New York Dairymen's Association at Watertown, that several subearth ducts had been put into cheese factories over there, at a cost of about $450 to $500, per factory, where the milk from 600 cows is received. The profit from the sales of cheese paid for the investment the first year. Mr. Smith next told what differences he found in the quality of cheese made the same day at the Station, from the same milk in the same vat. The process of manufacture was just the same till they went into the curing-room, where the temperature varied from 55 degrees to 80 degrees. Those cured at the lowest temperature being much finer and keeping much the better. These experiments were made July 27th, July 30th, August 1st, August 3d and August 8th. Practically, the results were the same. He also said that, at the Wisconsin Experiment Station, cheese were put into cold storage and frozen at 15 degrees. They came out after having been held there some time, and were found fine in flavor. There is no question, Mr. Smith said, that the temperature of the average factory curing-room is much too high, and that the putting in of subearth ducts would not only greatly improve the quality of the cheese but greatly enlarge the home market, resulting in higher prices.

Question.— Would you ripen separator cream or churn it while sweet?

Mr. Smith.— If one undertook to churn pure sweet cream, I think that he would have to have a plenty of time and a good deal of patience. Before cream is churned it should be thoroughly mixed, reduced to an even temperature, then warmed up and ripened by the addition of a "starter," made from pure, slightly acid milk — say a tablespoonful in a gallon. Warm up the mass to 68 degrees; in a few minutes it will be thoroughly mixed. Set it away, and the next morning the whole mass will be slightly sour; put it into the churn and in 30 minutes you will have the butter.

Mr. Rice.— It is quite a good many years since I worked the churn handle, but I think that sweet cream will not churn so quickly nor churn out so thoroughly as will ripened cream.

Question.— I have often had samples of milk taken and tested. Can one get good tests of milk kept one or two weeks?

Mr. Smith.— The true way, when milk is paid for on the basis of its fat, is by the composite test. Put a small piece of corrosive sublimate in a jar, and add a sample of milk every day. It will keep two weeks. Make a Babcock test of this milk. It will give about as nearly correct results as will samples taken every day and Babcocked separately. There are other ways, and there is another substance used for keeping the milk in the jars, but the corrosive sublimate is probably the best.

Question.— Will too much sweet corn on the ear, fed to cows, cause "stringy" milk?

Prof. Harding.— No. If such a condition of the milk appears it will come from some other source.

A Farmer.— My cows gave ropy milk when being fed sweet corn.

Mr. Smith.— Was the milk left in the same place as when the cows were not fed the sweet corn?

Answer.— Yes.

Mr. Smith.— Then the cause was not in the corn, but in some condition of the barn.

Question.— Can butter be sold at 20 cents a pound and produce any profit?

Mr. Cook.— It would depend on its cost. It ought to be made and sold at a profit at that price.

Question.— What per cent. of solids must milk contain to be accepted at the milk stations?

Mr. Smith.— The law of this State requires 12 per cent. solids, of which not less than 3 per cent. shall be fat. This law varies in different States. The average per cent. of fat in this State is 3.8. That is the average all over the State except in Delaware county, where it runs over 4 per cent. At the Hobart creamery, I think, it averages 4½ per cent. But nearly all the cows in that county are Jerseys.

Question.— Is not the nutritive ratio fully as high in 3 as 5 per cent. cheese?

Mr. Smith.— No; if it was, skim cheese would be the best; whereas it contains but little, if any, food value. The one I made at the Station last summer contained 43 per cent. of water, 40.70 of casein, and 5 of ash; no fat. In two weeks we could not cut it with a knife.

Prof. Harding.— We had to use an auger to get samples from that cheese for analysis.

SOME THINGS ABOUT PIGS.

Question.— What is the best food for a brood sow? The best way to feed grain, wet or dry?

Mr. Chapman.— The most rapid growth I ever knew in pigs was from a ration of corn meal and skim milk. As to feeding grain wet or dry to hogs, I do not think there will be found much, if any, difference in results. We grow many turnips, but, as they are a cold, watery food, conditions must be made good, and the turnips well balanced with protein foods.

Mr. Goodrich.— Mr. Theodore Lewis of Wisconsin, knows more about hogs than does any dozen men I ever saw. He feeds dry meal to his hogs.

Question.— At what age should pigs be weaned?

Dr. Smead.— I hate a hog above all farm animals, but I think that four or six weeks would be the right age.

Mr. Chapman.— I should not wean a pig at all. Just as soon as pigs are big enough, we sprinkle a little wheat in a compartment where the mother cannot get it. By degrees the pigs learn to eat it, and, therefore, suckle the mother less each day, until they desert her. This allows the mother's milk to dry up. But we may feed the pigs up to the age of eight weeks just as cheaply, through the mother. The difference in results will be found after weaning them.

Question.— Are wood ashes or bone meal good to feed to pigs?

Mr. Lillie.— We always give as many wood ashes as the pigs will eat. If the ration which is fed is too wide, we feed some bone meal. As a rule, however, we do not have to feed it to our pigs.

Question.— What is the best ration for pigs after they are two months old?

Mr. Smith.— Mr. Lillie of Michigan, who has been with us a part of the time this winter, and who feeds many pigs, uses, for pigs two months old, a ration made of 100 pounds of skim milk, 50 of wheat bran, and 20 of corn.

Question.— How much salt is a dose for a hog?

Mr. Stevens.— About half as much as for a cow. Put it where the hog can get it when it wants it.

Question.—What ails the pigs? At three months of age they become stiffened and eventually all the legs are affected; skin very red, and it is with great difficulty that they get upon their feet. The food has been corn meal and buckwheat middlings wet with whey, corn in the ear, with, occasionally, a feed of whole oats.

Dr. Smead.— That is quite a problem. Did any of those pigs die?

No answer.

Dr. Smead.— The pigs were attacked with rheumatic fever. They are more subject to rheumatism than is the human being, but, as a rule, they are the most neglected animals on the farm. The whole cause of the trouble with those pigs was mismanagement. The disposition of the hog is to eat more than he needs. He is simply a hog, and, when one eats all he can hold, if another hog is added and fed; he will get up and eat more, just to get it away from the other hog. Overfeeding with improper foods causes the disease. Do not feed carbonaceous foods. Keep the pigs growing and give them a warm, dry place to sleep. Scatter a little corn in the litter and make the pig hunt for it. Eliminate dampness. Too many farmers keep their pigs in the basement of their barns. Make the hog-pen warm, clean and light. Do not think the hog can stand cold. You will always find him seeking a warm nest. I should change the wheat bran to wheat middlings, and reduce the corn meal ration somewhat. Wheat bran is not as readily digested by the pig as are the middlings.

Question.— Can we afford to make pork at four cents a pound; if so, how can it be done?

Mr. Chapman.— I think it can be done if the conditions are favorable. I should want a thrifty pig, one that will grow and fatten rapidly. Sell them at 150 pounds. The first 100 pounds can be made the cheapest. Feed corn meal with skim milk, gradually increasing the quantity of meal. Do not feed in this manner if growing pigs for breeders.

Mr. Smith.— Pigs at that weight will sell readily at a greater price than four cents. Skim milk thus fed is worth 25 or 30 cents a hundred pounds.

Mr. Woodward.— A pound of pork can be made very cheaply upon rape. Have your land rich; sow rape in the spring as soon as the ground can be worked. Sow in drills 20 inches apart; cultivating once or twice, and when six inches high turn in your pigs. The more it is eaten the more it will grow. Sow only the Dwarf Essex variety, two pounds if in drills, or four pounds, if broadcast.

Question.— Can swine be profitably kept without milk? What is the best food for a brood sow?

Mr. Goodrich.— I have always fed milk, but it has been fed to calves. Have never fed it to pigs. I should think, however, that skim milk would be a good food for a brood sow.

Mr. Chapman gave his methods, which consisted of a variety of rations. Many flat turnips are fed, but they are well balanced. Not too many are fed at first. The quantity is increased and wheat middlings are added. Nothing else is fed during the winter. In the spring they run on rye pasture, then clover; later, oats and peas. This makes a largely vegetable diet. We do not care to feed much milk, except when the sow is suckling her young, which we never wean, but begin teaching them to eat other foods as early as possible. In this way, they gradually take less mothers' milk, which soon dries up.

Question.— What would you feed to the fattening hogs, in connection with corn, if you had no barley?

Mr. Stevens.— If I did not have the barley, I should add oats or some wheat middlings. I know of nothing better. But barley and corn make the best combination for the quality of pork needed in the markets.

Question.— What is the best breed of swine, and the proper weight to be slaughtered?

Mr. Woodward.— No one now asks for heavy, fat hogs, except for lard. When we go into a meat market and buy a chop, the butcher cuts off all the fat. Lean meat or "marbled meat" is wanted, and the pigs must be light weights. If any money is made from pigs, one must start early. The pigs must be farrowed in the spring and forced to a market weight as soon as possible, but the brood sows must be properly fed and cared for during the winter. They should have warm, dry, clean pens and be properly fed during the gestation period. But one ought not to use a razor-back breed. Get a modern pork breed. There are a number, but I am not here to name any particular one.

Question.— How do you feed your brood sows?

Answer.— I put 12 brood sows in the basement of a barn, last fall, and fed them nine bushels of cider apples per day — three bushels in the morning, three at noon, and three at night. Wheat middlings were fed in connection. Every sow farrowed healthy pigs and not one proved to be a cannibal. He named some other foods, among them mangels, fed raw and whole. Potatoes are a good food but they should be fed cooked. Clover is a good food for a brood sow in winter and Dwarf Essex rape, sown early, will furnish good pasture for the pigs. If you have skim milk, feed it; if not, feed the "house slops" with the middlings. "An acre of rape will furnish pasture for 20 hogs all summer." When the pigs reach 120 pounds add to the wheat middlings, skimmed milk and rape, some corn meal, to put a little fat on the meat; and, when they have reached 150 pounds, turn them over to the butcher. By following these rules, pork may be made for three cents per pound. I make it for about two and a half cents, but I buy the refuse beans from a bean picking factory, and grind them. They make an excellent food. Charcoal made from cobs, mixed with hard-wood ashes, with a little salt and some copperas, put in a box in the pen where the pigs can get at it, will keep them healthy.

Question.— What is the best food for young pigs?

Mr. Woodward.— Skim milk; next, wheat middlings, or both, mixed. When they are old enough to eat green food, give them Dwarf Essex rape; red clover is also good, but rape is the best, because it will grow right along through the dry weather.

Mr. Smith.— A gentleman recently gave me this formula: For pigs four weeks old, 150 pounds of skim milk, 20 pounds of wheat middlings and 15 pounds of corn.

Question.— Is there any profit in pork at present prices?

Mr. Witter.— It depends upon the man. No man can succeed who has no liking for his business. If you have, it is very profitable. The secret of success is to push pigs quickly to an early maturity.

A FEW REMARKS CONCERNING CALVES.

Question.— How can you test the milking quality of the heifer or calf?

Mr. Woodward.— There are certain indications that go to show the good cow, and we may find them in the calf. But, one may spoil the best breed and the most promising calf, by overfeeding or with improper foods. Do not get it fat but keep it in a growing condition. Oats and bran are good foods, with sweet skim milk, and early cut clover hay as soon as the calf is old enough to eat it.

Mr. Smith.— I have made up my mind that oats are fully as good as bran, if not better for a calf. But there is great danger from overfeeding, although the average farmer is not very apt to do it. But it may be done. There were a lot of calves spoiled in that way some years ago at the Geneva Station. Feed the calf a little at a time and feed it often.

Question.— Is it possible to grow a calf so that it will not make a good milch cow? Or, in other words, that it will become "beefy?"

Mr. Goodrich.— Yes. One may spoil the best bred heifer calf ever dropped by overfeeding it, or by improperly feeding it. It should be given foods that will keep it growing, not fattened. It must have protein. Skim milk and wheat middlings, with, later, oats and clover hay, are best. Give these foods until the calf is six months old.

Question.— Can we raise a good calf on these patent calf foods, without any milk?

Mr. Chapman.— I never used any. As far as I can learn from analyses it will be better to buy oil meal of dealers at, say $20 per ton, than to pay the patent feed dealers $400 per ton for it.

Question.— Can calves be fattened on skim milk and ground feed alone?

Dr. Smead.— It will depend on the age of the calf; I do not believe that a calf can be well fattened on other than mother's milk, wholly or in part, till after it is four weeks old. After that period, I think that skim milk with a little oil meal, together with some oats and clover hay, may be substituted for the whole milk.

Question.— Mr. Goodrich told us how to raise a calf upon skim milk. Now, will some one tell us how to raise one when the milk is all drawn to the station?

Mr. Richardson.— That is a question which those who take their milk to the station need to solve. We had three thoroughbred calves and not much milk. We made up our minds to keep the calves at home and see if we could not make them grow; so we mixed up some corn meal, wheat bran and oil meal in a bucket, making it thick, using hot water. We put a spoonful of this mixture, dissolved in hot water, into what milk we could spare when we milked the cow. In this way we grew them nicely. We raised the three, which are now on the farm. Later, we gave them some ground oats, and never had calves do better. But we do not draw milk to the station. I believe, however, it can be done without the milk.

Mr. Chapman.— I do not believe it will pay to try to raise a calf without some mother's milk for at least three weeks. One man may succeed in growing a nice calf without milk, but 90 will fail who try the experiment.

Question.— How many pounds of milk will it require to grow a calf to 150 pounds?

Mr. Aldrich.— I will have to do a little figuring before I answer the question. A calf weighing 80 pounds will require 600 pounds of milk. I made some experiments to find out how much milk was required to make a pound weight. When a calf was three or four days old it required seven pounds; the next week, eight pounds; the next, nine pounds, or an average of eight pounds; so that it required not far from 600 pounds to make a weight of 150 pounds at four weeks.

Question.— Will Mr. Gould describe a young calf that will make a good cow?

Answer.— I should first want to see the mother of the calf, then the calf, then the owner. A calf may be well-born and descend from good parentage, but be spoiled in bringing up.

Question.— What is the best food for a calf six months old?

Mr. Lillie.— Corn ensilage, clover hay and wheat bran — all it will eat. Oats will do, but they are too expensive.

Mr. Smith.— As a rule, people go to extremes in keeping calves. They give them too much when young and starve them later on. Feed the calf three times a day at first, a quart at a time, and increase the quantity proportionately as the calf grows older.

Question.— Should calves, to be raised, be allowed to suckle their mothers?

Mr. Lillie.— Some of the best dairymen I know do not allow the calf to suckle the cow at all, but we allow it once or twice.

Question.— Will Mr. Gould tell us how to raise heifer calves, in stable, first season, with hay, grass, clover and grain?

Mr. Gould.— Give it a good start on its mother's milk, then follow with skim milk and oil meal, and, later, oats. Clover hay should be given as much as possible. Do not feed any corn, but bran and clover and that class of foods. We feed our little calves very nearly as we do our milch cows. The calf will chew food, because its stomach is a milk one. As a rule, the calf becomes a ruminant at about the age of five or six weeks; or, in other words, when it begins to chew its cud. One of the darkest places is the inside of a cow's stomach. I doubt if a cow, which eats 40 or 50 pounds of ensilage per day, raises and remasticates it all.

Question.— Does it pay to veal calves at five and a half cents per pound, with milk worth $1.05 per hundred pounds?

Mr. Smith.— The farmers up in Jefferson county claim it does; I do not know.

Question.— What causes scours in calves? What will prevent it?

Dr. Smead.— There are two causes. One is overfeeding, or improper feeding from an unclean vessel. Very many times the calf is allowed to become very hungry, and swallows very rapidly the milk given it, which distends the stomach and causes indigestion. Nasty troughs, which one may smell as far as they can be seen, will cause the disease.

Captain Murphy.— The trouble with our calves is, they die from the disease before they are a week old.

Dr. Smead.— That comes from the causes I spoke of this morning.

Dr. Hatch.— I do not fully agree with Dr. Smead; I am of opinion that the cause is unbalanced rations given the mother of the calf.

Question.— Will the disease appear in calves whose mothers give only three per cent. milk?

Dr. Smead.— Yes; the per cent. of fat does not seem to make much difference with the disease.

Question.— I feed bran and oil meal to my calves after they are four weeks old, in milk and water. Can I improve the ration?

Mr. Witter.— It is an excellent ration, but I should feed the grain dry, after the milk. Digestion is begun in the mouth, where the feed is mixed with the saliva. If fed in the milk, this will not take place.

Question.— What should be added to separator milk to make a balanced ration for calves?

Mr. Witter.— As soon as they will eat anything, give them a few unground oats. A little oil meal is excellent. It has a medicinal as well as a food value. Bran and wheat middlings are also good.

SOME OF THE GRASSES.

Question.— Where clover fails, to what extent will Hungarian grass or millet take its place as a food?

Mr. Goodrich.— Hungarian grass is, probably, as good a grass for hay, except clover, as is grown. It has two-thirds as much protein in it as has clover, and considerably more than has timothy hay. But millet, as it is called, should be cut before the seed forms. When so cut and well cured, there is no danger in feeding it to milch cows. My rule is to fit the ground nicely, then sow three pecks of seed per acre. Some men sow a bushel.

Question.— If I cut my rye as soon as it blossoms, and cure it for hay, what will its value be, or to what extent will it take the place of timothy hay?

Mr. Goodrich.— Rye has as much protein in it, if cut just as it heads out, as has timothy hay. Do not allow it to grow too large; if you do, you will have rye straw.

Question.— When should millet seed be sown?

Mr. Goodrich.— We sow it in June. It should have about 60 days to mature, enough to cut for hay. The best crop I ever grew was sown the 7th of July, but the season following was very favorable for curing it. It should be cured in cocks, as is clover. All forage crops for hay should be cured in the shade. The old saying was, "Make hay when the sun shines," but all the sunshine needed is to take out the foreign moisture, dew or rain. The moisture in it, *i. e.,* juices, should be retained. It requires 8 or 10 days more to mature German millet, which produces a larger crop than does Hungarian, but the quality is not so good.

Question.— Which is the better, Hungarian or German millet?

Mr. Gould.— Both analyze alike. The question is, which can you get most of. But either must be cut before the seed forms.

Question.— Is it profitable to sow "orchard grass" either for meadow or pasture?

Dr. Smead.— I have never sown it, nor is it sown in my immediate neighborhood, but some of my townsmen grow it. If you want it for hay it must be cut just as it gets into blossom. It belongs to the same family of grasses as does timothy, but to get most benefit from it, it must be cut before the seed begins to form.

Mr. Woodward.— It is one of the best grasses for permanent pasture.

Mr. Dawley.— I tried it and am now being cursed by some of my neighbors. It went all over the farm and over the line fences. Unless it is cut before the seed forms it is worthless for hay.

Question.— Would you advise the sowing of "*Bromus Inermis*" — Brome grass, in western New York?

Mr. Smith.— I do not know anything about that grass.

Dr. Smead.— I mixed Brome grass with 10 other varieties of grass for a permanent pasture. It does not spread and so does not drive out other grasses. It comes up in what we call "bogs," making the pasture look like a wet piece of land. If the live-stock eat it closely enough it will answer, if one does not have anything better; but, like orchard grass, if it is not eaten before it becomes ripe, it is entirely worthless.

Mr. Dawley.— We have an acre of Brome grass. It is about like enlarged quack and just about as valuable for feeding purposes.

THE POULTRY YARD.

The matter appearing in the Poultry Department has been prepared wholly by persons who have taken active part in the work of the N. Y. S. Farmers' Institutes. The question-box discussion has been made an important feature, because it is usually direct to the point with specific information. It should contain something of value to all.

If you discover that the writers disagree, balance well their arguments and choose between them. If you disagree with the writers, consider carefully who is right before passing judgment. The writer may be wrong. So may you. No one man knows all there is to be known about even one branch of the poultry business. Therefore, no one is infallible. What we really known about poultry keeping could be put in a small book; what we think we know would make a heavy volume, and what we don't know would fill a good-sized library. So we must expect to go right along, making mistakes — being misled — and learning by experience. We are all students and teachers — giving and taking. Each one is hunting for the truth. The best way to get at the truth is to compare methods and exchange experiences. The underlying principle will be revealed. That is the purpose of the question-box. Each writer is responsible for his views. Upon their correctness he must stand or fall.

JAMES E. RICE.

HOW TO FIT FOWL FOR THE SHOW-ROOM.

Address delivered by J. H. Drevenstedt at the New York State Poultry Institute, Cortland, N. Y. December 19, 1900.

How to prepare birds for the show-room is a subject that is by no means an easy one. It involves so many little details which, if presented either here or elsewhere, would occupy much time and severe patience of the party of the first part — the lecturer — and the party of the second part — the audience. Consequently, I shall endeavor to make the subject as plain as possible within the reasonable limitations that it admits of. The bird that wins a prize in the show-room must be shown in good condition. It is true that a bird of transcendent merit may win, even if it is put in the pen minus the requisite toilet, but such instances are indeed rare. This reminds me of a little experience I had in judging cattle about 14 years ago. I found a Jersey heifer calf in the ring that had all the marks of a finely bred one. I gave her the prize over a lot of finely conditioned heifer calves, and the result was that the men who spent their time in putting their stock in "apple pie" order kicked. They could not see the point, viz., the fact that intrinsic merit won over inferior merit, notwithstanding that the latter had been hidden by magnificent handling and conditioning. A little serious talk over the respective merits of the winner convinced the showmen that I was right in my judgment and they admitted the value of the calf to be superior to that of those shown by them.

But this is an isolated case, and the same rule applies to chickens. Condition and the perfect preparation and training for the show-room will win many a prize for a bird which in intrinsic merit is several pegs removed from the birds that lose the ribbons because their owners fail to grasp the opportunities before them. A bird well shown is half the victory.

To fit a bird for the show-room we must begin with the chicken as soon as it has left the shell. From the cradle to the show-pen is the motto of all good fanciers. Allow but a week of negligence in feeding and care and the chances of its ultimate development into a crack show specimen are impaired.

The nursing of a child and its subsequent training as it grows older, under the careful guidance of intelligent parents will bring it to mature man or womanhood in perfect shape. Is there any difference in chickens? No. It only takes less time to do it. A chicken must be kept growing and growing all the time. It must be kept clean, free of vermin, and never pampered or overfed. Then when the show season approaches we have something to build upon, a sound, healthy structure that will not topple over when we put the finishing touches to it.

How is this all accomplished, you will say? Well, I will state a few facts. Last week I had the pleasure of visiting the famous yards of Mr. George W. Mitchell at Bristol, Conn. Mr. Mitchell has probably the finest poultry houses in the United States. Everything is arranged for the comfort of his fowls — or, I might say, his pets — the buildings are kept scrupulously clean, and the pens and training coops are in keeping with his ideas. Electric lights illuminated the buildings; not a speck of dirt was to be found anywhere that visitors trod or looked upon. He breeds Partridge Cochins, and we all know he breeds only the best that his brains, skill and patience can produce. I saw over 100 birds on the place. They were youngsters and all roosted on a bed of sand, except the more forward ones, and they had pens especially prepared for them. Their roosts were but a few inches from the soft sand. Now, here is where the development of the Cochin comes in. Leaving aside the feed, they were handled as all Asiatics should be — quietly and close to the ground. But this is only the kindergarten stage. As soon as they are in good feather, they are placed in the training coops and taught to pose and to be handled. That involves labor, but it wins many prizes.

I remember Mr. George Purdue, the famous Light Brahma breeder, once telling me: "You can feed and condition a bird and bring him up to the height of perfection in a physical sense, but he is not finished for the show-pen." That is true and I saw it illustrated at a New York show some six years ago by the same Mr. Purdue. The latter won a prize with a bird that, when the judge touched him, posed like a statue and hypnotized the judge; another bird, equally good, when examined, went to pieces. It was a case of fine handling, and that is a part of the secret of showing birds.

The above are but general illustrations of what can be accomplished by proper handling; but there are natural advantages in producing birds for the show-room that must not be lost sight of. Many of us recollect the fine condition and wonderful plumage of the turkeys Mr. "Fred" Crangle used to show when he was with Fisher's Island Farm. Those turkeys were allowed to run among the bay berry bushes to feast on the fruit, and when they were corralled in the autumn they fairly glistened in the sunlight and were in the pink of condition. Nature and proper food did the work in a few months that years of artificial feeding never would accomplish.

Just so with Games. The fine, graceful lines, grand stature and hardness of feather that make up the ideal show Game can only be secured by following the laws of nature in the building up of the framework. Successful exhibitors of Games rear their birds in the field and forest and not in the back lot. The free range and unlimited forage, with a grain diet, consisting principally of oats, will bring forth strapping healthy specimens in the fall that will stand the training coop without loss of strength and vigor. The finishing touches are easy when the foundation has been properly laid.

The training of a Game bird for the show-pen is of vital importance. A coop shy bird, no matter how good he may be, will lose the prize nine times out of ten when it confronts the judge. The moment he is touched the trained bird will pose and do his level best to "show up," and that wins many a blue ribbon. It is not difficult to train a bird provided the owner is in sympathy with it. Birds love to be handled and fussed over.

When I was at the Philadelphia show last week I met Rajah II., an Indian Game cock who won first at New York as cockerel last year. I remembered his posing and when I tickled him under the chin and stroked his back he posed like a statue, showing his beautiful and symmetrical lines to the very best advantage. He would stand for a minute without moving.

The same might be said of Game Bantams. Take such past masters of the art as B. C. Thornton, A. A. Parker and John Glasgow and note the wonderful condition and training of their birds. Is it any wonder that they win?

Leghorns and Hamburgs require the same preliminary treatment that Games do. They need the muscular development first and then the finishing touches in the fitting-room or coop. Many birds of these varieties have their combs enlarged and spoiled by too early cooping and feeding.

As to white fowl, I am inclined to think that a shady orchard sown to clover is the best preparatory school. The chickens will come out in the fall with nice white plumage and good yellow legs and the final preparation is but a bagatelle. I am aware that many exhibitors prepare their fowl months ahead by cooping them in the fitting-room and not exposing them to sun or rain. This may result in a white plumage, but at the expense of the color of the legs and the constitution. I have known of a fine strain of White Leghorns being absolutely ruined by such treatment.

All the above applies to the natural treatment of fowl. We now come to the artificial methods employed to improve their form and looks. Washing fowl for the show-rooms is often a necessity. It is not a difficult job by any means. A thorough warm washing with Ivory or Castile soap, two or three rinsings in pure lukewarm water, careful drying at a fire, not too hot, and the final rubbing down with a silk handkerchief will work wonders in white fowl and even Barred Plymouth Rocks. Another important thing in preparing parti-colored fowl for the show-pen is the removal of old or dead feathers. Even new ones can be removed to advantage when they are in the way. This is not faking; it is simply getting the birds in "silk attire." Removing false or foul feathers is another important matter. As long as we allow color disqualifications in the Standard of Perfection, this will go on. A single red feather in the crest of a Creve Cœur cock disqualified the finest bird of this breed we ever saw. The owner said he would not pluck the feather because he did not believe it honest to do so, and at the same time condemned the Standard. That honest man has long since given up the fancy. The cleaning of the legs of fowl with sweet oil and turpentine, the saturation of the comb with alcohol or vaseline are all legitimate tricks that make up the fowl showman's trade.

The singeing of feathers to hide disqualifications, the excision of white in red earlobes of white or grey tips in black feathers by graphite, shoe dressing or dyes, the coloring of legs with iodine or similar preparations, the plugging of holes in the shanks with beeswax, and numerous other arts of faking should be universally condemned. A fowl that cannot be fitted for the show-room without the above had better be left at home and save its owner the opprobrium that is sure to be heaped upon him when his faking is discovered.

Question.— What is the best form of house for Bantams or other fowl, when space and money are limited?

Mr. Davenport.— The small, low house has always given us the best results for Bantams. We use drygoods boxes. Take one three by four feet on the ground, raise one side so that the roof will have a little pitch, cover it with tarred paper, put a small window in front and a door in the front or end, as suits you best. We put the nest boxes on the floor, the dropping board over nest boxes and the roost still six inches higher up and close to the roof. For our laying-houses we buy upright piano boxes. Three piano boxes will make two houses. The boxes cost anywhere from $1.20 to $2, according to the section you are in. We lay the box down on its back and make the bottom of the box the front of the house, and raise it up to four feet in height; put a seven by nine window in about one foot from the floor, and in the end we put a 20x30-inch door. Our roof will slant from the four-foot front down to the slant that is already in the top. We make three nest boxes 12x14x10 inches high and put on the floor under the lowest part of the roof. Over this we put a dropping board, two and one-half feet wide, and four inches higher up we put our roost. In the end opposite door we cut an 8x12-inch hole with a slide for our fowl to get in and out. Then a coat of paint and our house is complete. The roost, dropping board and nest boxes should be loose so they can be taken out and cleaned. We have used these houses with great success and have had them out all winter in the coldest climate, the thermometer going down to 25 and 30 degrees below zero; but if it was possible we would prefer to have a shed to put them under in the wintertime, so as to give the fowl a chance to scratch. We keep from 16 to 25 old birds in each house, and have had as high as 28 "Rocks" in one house all winter and have them lay all the time. These houses are handy, can be moved easily and any one having grain lots where they would like to have their hens, can set this house, hens and all, on a stoneboat and move them to the lot on short notice. They are a good colony-house and save building lots of fence where several different kinds of poultry are kept.

Question.— How can we get uniformity in judging? Isn't it a fact that poultry judging is quite as much of a profession as is the practice of law or medicine? If so, should not our judges be fitted for their profession the same as are our lawyers and doctors?

Answer.— The exact uniformity in judging poultry would call for the same preference in all mankind. Such conditions would lead us all to select the same manner of form and color, but so long as mankind have their several opinions on other matters just so long will they differ as to their opinion on fowl. While poultry judging is a calling after the fashion of the practice of law or medicine, there is still quite as many opinions as to the letter of the law or the practice of medicine as there is in the selection of the best fowl. More education in this line will make better judges, but cannot change the many opinions.

Question.— What is the cause for black appearing in the flights and tail of buff-colored fowl?

Mr. McGrew.— The original Buff Cochin had considerable black in wing and tail. This has not been entirely driven out as yet. In fact, some of the best specimens produced each year still show a tendency to black in tail and flights. They being one of the foundation crosses for the production of both the Buff Plymouth Rocks and Buff Wyandottes, it is not surprising that the black still appears, and in addition to this, both have been crossed with other Wyandottes, also Rhode Island Reds, the combination having bestowed upon them almost an endless heritage of black in wing and tail.

Question.— Is it safe entirely to breed out the black which appears in the flights and tail of buff-colored fowl?

Mr. McGrew.— It is quite safe to do so if it is possible to gain pure solid color and maintain the true buff shade. The great danger in so doing is considerable .loss of color, followed with white in undercolor. The safest method for obtaining and maintaining true golden buff is to continue to mate together the truest colored specimens year after year, so as to establish a strain that will breed true to color. When black must be present, it should be confined to a shading or penciling of darker color on the maintail feathers.

Question.— Isn't there a tendency for Plymouth Rock breeders to breed too much toward Wyandotte shape, and vice versa?

Mr. McGrew.— There is entirely too much licensing, on the part of all, as to our positive demand for true breed characteristics. This is not only true with the American breeds, but too true with all. The cushion has no right upon the back of the Plymouth Rock. At the same time, it is favored by many. The Plymouth Rock family have the medium length of back and body; the Wyandotte the short, compact form. Breeders, as a general thing, pay rather more attention to color than to form.

Question.— Would you breed from an otherwise valuable male single-comb White Leghorn if he had a strong tendency to squirrel tail?

Mr. McGrew.— I should not make use of a squirrel-tail Leghorn under any conditions. They are often used for the following reasons: If you have a lot of females that carry their tails too low and close together, it is thought that such a male will help to elevate the tails of their offspring, as well as to expand the tail feathers. If such is the case, it will also stamp into the blood the tendency to squirrel tails. I have seen wry tails so worked into the blood of a strain that three-fourths of their whole product would be so affected. There are too many good specimens in the world of the White Leghorn breed to waste time in the use of a disqualified bird.

N. B.— A true squirrel tail must lean forward so far as to touch the back of the fowl's neck. Some Leghorns bow their neck so much that it will touch a tail so carried; that upon another it would not nearly touch the neck. The Standard tells us that the tail of a Leghorn shall be carried well up, but not upright. Too many lean to a tail carried more than upright. The too-high carried tail is not correct.

Question.— Is it advisable to breed from a male bird that is solid black (like a Minorca) that has an occasional red feather in his plumage?

Mr. McGrew.— Red showing in the plumage of black fowl is supposed to indicate an excess of rich color. Such birds are often made use of by expert fanciers to improve or intensify the color of the young stock. The result of such matings is often a few very rich-colored males and females. It is always best, in the long run, to depend entirely upon the true colored males and females of all black fowl. Breed together the truest colored ones you possess, for in this way you will establish true producing qualities that can be depended on; while, if you encourage bad color, it is apt to crop out when least looked for or desired. It is thought that this red color comes from the Malay of years back, like the red wing bow of the Cochin, or red showing in any part of the top color. It is best not to foster these undesirable colors.

Question.— Do you favor crossing breeds of fowl for layers?

Mr. Chapman.— No; my experience is that after the first cross they are good for nothing, for the reason that one never knows where he is going to land. Leghorns and Plymouth Rocks are radically different in habit and other vital points.

Question.— What ought one to pay for a good thoroughbred rooster?

Mr. Chapman.— You ought to be able to buy a good one for $1 to $3. Such a bird, if well bred, will be just as serviceable for your purpose as will one costing $10. If you will, when ordering, say you do not want the bird for show purposes, you will, no doubt, get one for $1.

Question.— Will it pay to buy a pure bred male to mate with common hens?

Mr. McGrew.— It will, providing he is individually good. It often happens that males so selected are deficient in the three most important features, size, strength and vigor, all which are very important, if it is our wish to have his blood most deeply stamped into his progeny. An example: Mr. Wilson had about 50 so-called common hens; he killed all his male birds during the winter; we secured from him three very thrifty Barred Plymouth Rock cockerels; during the summer and fall, all the original hens and all the young stock except the pullets that showed the Plymouth Rock color were sold to market; the selected pullets were kept with the same three Plymouth males; the next fall the best pullets were selected to keep; all the rest sold, including the three Plymouth Rock males; their places were filled with four very thrifty, sturdy Plymouth Rock cockerels. After another season no one could have told the fowls from true Barred Plymouth Rocks. • The great drawback to these crosses is their tendency to create mongrels. First we use a White Leghorn; next a Brahma; then a Wyandotte, and each season brings a new cross, which complicates the situation. If you buy a pure bred male to cross upon common hens, continue year after year to use the same breed of males that are selected for the sturdy qualities and health, rather than for color.

Question.— Which are the best breeds of Bantams for farmers' children?

Mr. McGrew.— Brahma or Cochin Bantams, for the reason that they are more sturdy and less apt to suffer from indifferent housing and care in winter. I have known a brood of them to live all winter in a store box where the mother hen reared and left them at weaning time. They did better outside in this box than did others of the same age that had a warm house for their winter quarters.

Question.— Is there any profit in keeping Bantams? What advantage have they over larger fowl?

Mr. McGrew.— Those who breed Bantams to fancy exhibition qualities can and do make some profit from their culture. The handling of Bantams in any other way cannot prove profitable. Bantams are much valued by those who have small, confined quarters for their yarding, as in our large cities, where a half dozen can be kept for pleasure and the production of a few fresh eggs for family use. Their eggs are prized highly for children and invalids. If comfortably housed and properly fed they will lay about as many eggs as other fowl. If kindly treated they will become as tame as a cat or a dog. They eat so little that the eggs they do produce are about all profit, and they are beautiful for table use, either to boil or fry, at any age.

Mr. Davenport.— Three questions in one. The Buff and Black Cochins seem to us to be favorites as they are very quiet, not easily scared, great pets, good layers and good mothers. The chicks are easily raised and are always in good demand. They sell well and many fanciers say there is double the money in them there is in the larger fowl. This is certainly so where space is limited. Not long since we saw 15 of these little birds kept on a space of 8x15 and their coop was 2½x3, 20 inches high at back and two feet in front.

Question.— Why is it that there are not more farmers raising thorough-bred poultry?

Mr. Davenport.— This is a hard question to answer. Our idea is that it costs too much to get stock to start with and they do not seem to understand that they can raise thoroughbred stock just as easy and just as cheap as they can common stock. Then the most of the farmers think that the time spent in taking care of the poultry is so much time wasted or thrown away, and if you ask a farmer why he does not put in thoroughbred stock, he will tell you it costs too much to buy the eggs and he cannot spare the time to fool with them.

Question.— Which is the best way to introduce new blood into a flock: to buy a pure bred male, a female, or eggs?

Mr. McGrew.— Much depends upon the result you desire to bring about. If you simply desire the new blood to strengthen and build up vigor and egg production, this can be accomplished most satisfactorily by introducing strong healthy males into your flock. If it is your wish to improve or give new blood to a fine strain of thoroughbred fowl that you have bred in line for some time, introduce the new blood through the best female you can secure. Either or both of these methods can be followed a year later with the outcome of eggs purchased the year before, providing you are sure the eggs are from good stock and the chicks from them are fine individually. Two points must be kept in sight: Always demand sterling individuality; to this must be added high-class breeding. The good breeding is lost upon a poor specimen; but the grand individual, even if poorly bred, can transmit vigor, size and good health — both combined is the desired specimen.

Mrs. Monroe.— If one is starting from the foundation without fowl pure bred, introduce new blood from *eggs*, but if possible, visit the yards from which such are bought. After that introduce new blood through the female. Keeping the same type of male bird. By this method it is also possible to determine the laying qualities of the new blood. A male bird from a poor layer would undo the work of years, along the line of increasing egg yield.

Mr. Chapman.— The most satisfactory way, all things considered, is to buy eggs, as no disease can be brought to the farm. I have known cases where a single fowl has caused a loss of nearly all of the home flock by introducing some contagious disease.

BUILDING POULTRY HOUSES.

Question.— Do you prefer the " scratching-shed principle " in a hen house? Why?

Mrs. Monroe.— I prefer the scratching-shed principle, because I think hens are hardier and stronger by working in the open air. In the spring when the eggs are used for hatching, stronger chicks and more of them are hatched from hens so raised and kept. These houses are also pleasanter to work in, and are always dry, if muslin curtains are used for stormy weather.

Question.— Would you recommend open front or scratch shed houses and have a tight roosting room back? Or would you make it all tight? How ventilated?

Mr. McGrew.— The open or scratch-shed house for laying hens is fast losing favor in the colder climates. Inclosed rooms are most favored by those that have had the greatest experience. The best way, if possible, is to have a large open room with a good, deep sand floor, well covered with litter, in which the fowl can dig. Such a room should have only enough glass windows to furnish light sufficient for their comfort. A closed roosting room attached to the same is best. The whole should be built to furnish good protection from the cold.

Indirect ventilation is always the best for winter. The best form of indirect ventilation is to have the roof of the hen house sealed up so as to make an open air space between the inside lining and the roof. One or more outside ventilators should connect with this air space and the inside ventilation should be carried into the air space from the highest point in the room. Close to the floor would be better if possible, but this can seldom be arranged.

Question.— Is it advisable to build two-story poultry houses?

Mr. Chapman.— Where the site is sloping, a two-story building is cheaper, as convenient in all ways, and saves steps. I like mine and should advise their use on hillsides, &c.

Question.— What is the best elevation, front and rear, for a poultry house?

Mr. McGrew.— Low-built poultry houses are the best. If just high enough for comfort in the rear, they can be considerably lower in front. If high enough to move about in, they are by far the best for the colder climates.

Question.— Why not have the poultry house run north and south so the sun can come in from both sides?

Mr. Chapman.— Too many windows, making the building cold. The south side gives a continuous exposure all day. The north side gives shade in hot weather.

Question.— How much glass should there be in a house for 50 hens? How near to the floor should the windows be placed?

Mrs. Monroe.— If the house is built on the open scratching room and closed roosting room plan one window in each roosting room, about a foot from the floor. If closed house, one window (two sash) for every 15 feet in length of house.

Question.— Which floor is best in a chicken house, boards, or ground, or cement? Why?

Mr. Smith.— A board is better than a ground floor, and a good cement one is better than either. What is needed in a chicken house is dryness. Boards or cement, if covered with litter, make the best floors for that purpose, and are easier to keep clean than are ground floors.

Mr. Chapman.— The best floor for a hen house is Portland cement. Moisture does not come up from below, and it is easily cleaned. I value it because it keeps out rats and other vermin.

Mr. McGrew.— Dry floors are always the best. Dry earth floors should always have the preference. Dampness being the most injurious condition possible for poultry, absolutely dry floors should be maintained. When dampness is present, dig out two or three feet, fill in with gravel and broken stone and then either cement or fill in with clay and sand as seems best for the absolute guarantee of dry floors.

Question.— Why does Mr. Chapman bank his hen houses?

Mr. Chapman.— The frost goes through a solid stone wall; so I prefer to bank it. A double wall, one wide enough, with an air space in the center, might perhaps keep out the frost.

Question.— What is the best litter for a poultry house?

Mr. Chapman.— Buckwheat hulls absorb moisture, are light, and the grain settles into them. They will keep sweet and clean longer than any other substance known. I use different depths, from 2 to 12 inches in different parts of the house and under the roosts.

Question.— What are the women going to do when the men do not provide a suitable house for the hens?

Mrs. Monroe.— When a woman demonstrates the profitableness of poultry, a man will be apt to take pains in putting up a house.

Question.— At what temperature should a hen house be kept for best results?

Mr. Chapman.— The hen does not require as high a temperature as does the cow. I think a temperature of 40 degrees high enough, and I should allow four square feet of floor space for each hen. Some experiments have been made in warming hen houses with artificial heat, but I do not think they have been really successful.

Question.— Is the "trap nest" a success?

Mrs. Monroe.— I find the "trap nest" very useful in many ways. As to its perfect reliability, I find some hens that never lay in the trap, but take a corner of the dust bath, or some other place in preference to the trap. The only "trap nest" I have used is the Eureka. If I were doing an "eggs-for-market business," I should use "trap nests" constantly. I have used "trap nests" several years, but not at any time with the object of determining the exact number of eggs laid by an individual hen. I cannot keep this record, because I am constantly selling birds and taking them away from the pens to fit for shows or to exhibit.

Question.— Do you think a dust bath necessary?

Mr. Chapman.— Fowl will live, unless covered with vermin, without a dust bath, but will not be profitable or as healthy as they would with it. Many people who feed enough, have good fowl and warm buildings, fail because they neglect some such point.

Question.— How many square feet floor space should be allowed per hen?

Mrs. Monroe.— As much as possible. My hens have eight square feet per hen, and do well where there are 25 in a pen. If the pens were double size more hens per square foot would do well.

Question.— How large should a building be to keep 50 hens?

Mr. Lillie.— A building 15x25 or 30 feet will do. I should divide it and make a scratching shed of one-half. Make the other part warm and keep the hens comfortable.

Mr. Jennin.— Three square feet where scratching shed is used. Four square feet where no scratching shed is used.

Question.— What manner of poultry houses would be the most economical and profitable for the caring of large flocks of poultry? How many of the American varieties should be kept in one room?

Mr. McGrew.— The size of the poultry houses must depend largely upon the space that can be allotted to them and our ability to build. The most profitable house is the one that furnishes sufficient space in which the fowl may hunt and dig for food without crowding upon each other. Twenty-five hens of the American varieties are as many as should be kept in one colony for the best results. We have seen this number do well in a room 10x12, but they will do better if a space of 10x14 or larger can be allotted to them, if confined all the time during cold weather.

Question.— What number of hens should be kept in a flock?

Mr. Chapman.— It don't make any particular difference. I know a man who has 400 in one long building; but the trouble with so large a flock is the difficulty experienced in feeding them. About 40 in a flock will be found best.

Mr. Jennin.— Twenty to twenty-five.

FEEDING POULTRY.

Question.— What is a balanced ration for hens?

Mr. Chapman.—A ration that contains in proper per cents. the elements of the egg, which are fat, water, albumen, etc. A good one is two parts of oats, two of buckwheat and one of wheat. Sweet skim milk is also fed, and a bushel of beets every day to about 300 hens.

Question.— What is the best method of feeding hens for egg production? Give in pounds the kinds of foods used in the ration.

Mr. Rice.— We scatter wheat, corn, oats and buckwheat in the litter on the poultry house floor in the morning, and make the hens work for it. At noon we feed a ration made of 100 pounds of wheat bran, 100 pounds of wheat middlings, 100 pounds of corn meal, 100 pounds of ground oats and 100 pounds of meat meal. It is mixed and fed as a warm mash. At night feed same as morning.

Mr. Jennin.— For 100 hens, rations for 1 day, 16 pounds corn, 9 pounds oats, 6 pounds bran, ¾ pound beef scrap.

Mr. Stevens.— I have experimented with a large number of foods for winter feeding, and find that a ration made from 100 pounds of corn meal, 100 pounds of ground oats, 200 pounds of wheat bran, 100 pounds of linseed meal, 25 pounds of buckwheat middlings, and 25 pounds of animal meal, scalded, is best. I find that a laying hen requires one-eighth of animal food in its ration. For whole food, oats and wheat mixed half and half, is the best. At night, if the weather is cold, add some corn. We feed the "warm mash" at noon.

Mr. Chapman.— The best method of feeding fowl for egg production, in my estimation, is a light grain ration in the morning, buried in the litter, consisting of equal parts of corn, wheat, barley, oats and buckwheat. At noon a feeding of beets, cabbage or other green food, followed by a warm mash, consisting of boiled potatoes, cut clover hay, meat and ground grain, not exceeding one-half the bulk. The ground grain to be one-quarter corn, one-quarter oats and one-half wheat bran. Skim milk, oil meal or meat in varying quantities as the fowl will stand, watching for indications of bowel trouble and constipation.

Mr. Van Dreser.— Our ration is: Morning — wheat or oats or buckwheat scattered on the floor in litter. 10 o'clock — Mash, composed of 100 pounds each of corn meal, wheat bran and wheat middlings and 25 pounds beef scrap, all mixed with hot water and fed warm.

Question.— Is there any way to make hens moult in August? How?

Mr. Van Dreser.— Yes. Reduce the feed about the first of August so they will stop laying and loose flesh for about 10 days, then start to feed them with a rush, feeding heavy feed and sunflower seed. The oil in the sunflower seed causes the old feathers to drop off and new ones to grow in their places, so that they are replumed and ready to lay in early winter, when eggs are high.

Question.— Will cabbage affect the flavor of the eggs?

Mr. Chapman.— Not if fed in small quantities. I have heard it asserted, however, that it would, but I do not think that cabbage is affecting the flavor of many eggs this winter.

Question.— Does Mr. Stevens consider carrots or raw beets a perfect substitute for raw cabbage for winter feeding to the hens?

Answer.— I should prefer mangels to either of them. In some markets there is objection made to the feeding of cabbage to laying hens, because of the flavor it imparts to their eggs. Sugar beets, however, are not as injurious as is cabbage.

Question.—Do hens need condition powders to make them lay?

Mr. Van Dreser.— We never use them.

Question.— Does it pay to feed the so-called "animal meals"?

Dr. Smead.— As a rule, it does. Nearly all the hen foods are compounded for egg production. The hen, to produce eggs, must have foods that contain a good percentage of protein. These foods usually contain this element. But, if one can buy meat scraps and bones from the butcher shops, and cut them up, it may be cheaper to buy them than the animal meals.

Question.—What kind of meat meal does Mr. Rice recommend?

Answer.— There is more than 15 per cent. difference in the feeding value of animal meals, all sold at nearly the same price. Write to each of the manufacturers, get guaranteed analyses and prices, then buy from the one who makes lowest prices.

Question.—What will take the place of meat for my hens?

Mr. Smith.— Any of the prepared animal meals will do. They may be bought of any dealers in cattle foods. All poultry growers, nearly, buy and feed these meals.

Question.— Do you think it profitable to lime eggs when cheap in price and sell them for fresh eggs when the prices are high?

Mr. Rice.— Limed eggs are better than none, but not as good as fresh ones, and the man who will sell limed eggs for freshly laid ones ought to have a whole crate of them smashed in his face. There is no moral honesty in any such contemptible transaction.

Question.— How much will it cost to keep a hen one year? Should she be confined?

Mr. Lillie.— We keep our hens for 50 cents a year. We have 500. Probably the cost is from 50 to 75 cents per hen. They are kept in the houses a part of the time and are out for exercise a part.

Question.— Will the same quantity of food raise and maintain a Brahma or Plymouth Rock or Wyandotte, as a Leghorn?

Mr. Rice.— Oh, no. There are fully six to eight pounds of Plymouth Rock or Wyandotte to maintain as against four pounds of Leghorn. But the per cent. of cost of meat will be less in the former than in the latter. On the contrary, as a rule, the cost of eggs will be less for the Leghorns.

Question.— How many eggs can a large flock of hens be forced to produce in one year?

Mr. Chapman.— I know a man who kept 600 hens which produced in one year $2,547, at a cost of $600, or $1 per hen, thus leaving a net profit of $1,947. Some results were given from a flock of 400 hens which produced $875 or more than $2 each. The 600 flock produced an average of 196 eggs each, while the average number in this State is only 60 per hen.

Question.— Is it well to feed more corn to hens if the buildings are cold?

Mr. Rice.— If the weather is very cold and the hen house cold too; or, if the hens are poor, feed more corn. If the houses are warm, the hens in good condition and laying eggs, do not feed corn alone, except at night.

Question.— Is broken glass too sharp for hen grit?

Mr. Rice.— I should say so. Glass is pretty sharp and dangerous to feed. Some variety of grit, like cracked oyster shells is much preferable.

Question.— Would you keep grain before poultry all the while?

Mr. Jennin.— No, for laying hens; yes, for growing pullets.

Question.— What is the use of shelling corn for hens?

Mr. Van Dreser.— None.

Question.— Is it a good plan to parch corn for hens in winter?

Mr. Jennin.— No; corn or oats should be warmed in cold weather, not parched.

Question.— Give the best method of feeding little chickens.

Mr. Jennin.— For first week, johnnycake and boiled rice; second week, alternately johnnycake, cracked wheat; third week, cracked wheat; fourth week, cracked corn, cracked wheat alternately; after four weeks, cracked corn and occasionally some beef scraps.

ANENT TURKEYS.

Question.— Are turkeys profitable?

Mr. Chapman.— Where properly cared for they bring in quite an income. One farmer's wife I know has had $1,000 to spend from this source, in the last 20 years. Many wives have no income.

Question.— What do you feed young turkeys?

Mr. Chapman.— Nothing for two days and then a light feed of dry bread crumbs. They need but little when the mother is in large yard or in the field.

Question.— How can you keep turkeys at home?

Mr. Chapman.— They are quite methodical in their habits and take about the same round each day. Confine the hen turkey to a small yard for a week, and then let her out after dinner. Keep watch of her, guiding her in a circle within the limits of your own farm, bringing her back to the yard at night. After a few trials she will go over about the same round each day and come home every night.

Question.— Don't they do more damage than they are worth?

Mr. Chapman.— Turkeys left to pick for themselves are likely to injure anything edible they can find, but where well fed every morning with grain will only eat bugs, insects, and worms; and are worth a good deal to the farmer by thinning them out. Unless starved to it they do but little, if any, damage.

Question.— What is a balanced ration for turkeys?

Mr. Chapman.—The young turkeys are killed by overfeeding more than by any other way. Do not feed the birds till they are two days old. Then mix some stale bread and milk and feed it a day or two. Then open the gate and allow the mother and brood to shirk for themselves. When you want to fatten them, feed boiled potatoes, corn meal and like foods.

GENERAL MANAGEMENT.

Question.— Does it pay to caponize; if so, at what time and what breed?

Mr. Rice.— If one is rightly situated, the market near by and the prices just right, there is sometimes money in capons. We caponized 100 one year, losing not more than half a dozen. But we were satisfied we could have got more money by selling the cockerels when young, as broilers. I should not recommend going into the business.

Question.— Are eggs an economical article of diet, at more than a cent each?"

Mr. Rice.— Yes; ordinarily a dozen eggs are worth as much for food as is a pound of beefsteak. People often sell eggs at a cent each, then buy beef at 15 cents per pound and lose money in the transaction. Eggs are more digestible than is beef, while they can be cooked in more ways. To-day, the egg is the most popular "meat" at the hotels. As a rule, 60 per cent. of the hotel guests call for eggs. Every farmer should have them in the house every day in the year.

Question.— Can eggs be profitably produced at a cent each?

Mr. Rice.— It will depend on the hen and the management. Egg production is the test. It will cost about 23 cents a day for food to keep 100 hens. The droppings, if well preserved, will pay for care. If a hen only lays 100 eggs in a year, they will cost nearly a cent each if the hen is properly fed. She must lay a greater number. If you get a profit at a cent each, you must have egg producing hens, producing at least 160 eggs a year.

Question.— Can any one afford to sell eggs for hatching from first prize winning stock, at $1 per setting? The above means prize winners at large shows.

Mr. Rice.— If he can't get any more for them, yes. It would be better than to sell them for 15 cents per dozen. But, if a man has prize winners he ought to get $2 to $3 per setting for the eggs for breeding purposes. I know a man who gets $5. No man who has such stock as he should breed from, can afford to sell eggs for incubating purposes for any such price as $1 per setting. To breed really good stock requires great care and skill. We select all our breeding hens from the flock and put them by themselves. Have just selected 350 out of a flock of 600.

Question.— Will Mr. Chapman tell us how to cure a hen that wants to "set?"

Mr. Chapman.— Put her into another hen house, or shut her in a coop and do not feed her anything for a day or two. This treatment will cure a Leghorn, but not always a Plymouth Rock.

Question.— Can you determine the age of a hen after she is a year old?

Mr. Van Wagenen.— An expert will tell nearly a hen's age by her looks, but I think the larger poultrymen keep a record by punching out a little piece in the foot, or elsewhere, when the hen is a pullet.

Question.— How shall we make hens lay in winter in Denmark (Lewis county)?

Mr. Chapman.— If a man comes along and tells you that he can make yearling hens lay all winter and does it, he is smarter than I am. But pullets may be made to lay all winter, even in Denmark. Have the chicks hatched early in spring, so that they will begin laying at, say six months, or before cold weather begins; with such pullets, properly housed and fed, eggs may be produced all winter. But eggs are now worth 30 cents a dozen, which is the best evidence that but very few hens are now laying eggs.

Question.— What is the best way to apply hen fertilizer to garden culture or vegetables?

Mr. Rice.— Hen manure is valuable. It is rich in nitrogen, but deficient in phosphoric acid. So we use dissolved South Carolina rock under the perches. This keeps it dry and locks up the nitrogen. Never put wood ashes under the perches, or lime, either. They will absolutely drive the nitrogen out. Land plaster is good, so is road dust to use as absorbents. At least 40 per cent. of the nitrogen in hen manure can be lost where it is allowed to heat without absorbents. Care should be used in applying it to garden vegetables after they are planted. It may burn them. Its value will depend somewhat upon the quality of food the hens are fed. We usually mix the droppings with other manures and get it on to the land where we intend to use it, as soon as possible after it is made.

INCUBATING AND BROODING.

Question.— Are incubator chickens as healthy as those hatched by hens? Do you prefer incubators for hatching chickens? Why?

Mr. Chapman.— I have never been able to detect any material difference, where incubator was handled properly. I prefer incubators, because they do not fight and break the eggs, are less work to care for, do not breed lice and set when I want them to.

Mr. Jennin.— Yes, providing incubator has been run with proper ventilation and at a moderate temperature, say 102 degrees, no higher, as higher temperature weakens the chicks. Incubator, because the incubator is always broody, and can be depended on to stick to business. Also when a large number of chicks is wanted, it is cheaper.

Question.— What is the average number of chickens which can be produced and raised from 100 incubated eggs.

Mr. Chapman.— If a man gets 75 chickens from 100 eggs, hatched in an incubator, I think he will be doing well. We often read of 99 per cent. of hatched eggs, but they were not from the first eggs put in, because at the end of every few days, the eggs are tested and all eggs not fertile are thrown out. Later, when dead chickens are found in eggs, the eggs are replaced by new ones. In that way, as many as 99 per cent. of the eggs that passed as fertile or with live chickens in them, hatch. We raise 75 per cent. of those hatched.

Question.— Would you risk high priced eggs in the incubator?

Mr. Rice.— Certainly; why not? We are risking them and have been ever since we began keeping poultry in any considerable numbers. Indeed, we could not get along without an incubator.

Question.— Is the incubator a success? Are those heated by hot water better than those heated by hot air?

Mr. Rice.— The incubator is certainly a success. Moreover it is almost a necessity. The hens do not want to "set" early enough to give us chicks for fall and winter layers. I know of no advantage of the hot water over the hot air incubator; we have had experience with a half dozen different patterns — all very good, and most of them have some advantage that others do not. We now use the "Prairie State" and "Cyphers." If you are going to invest in an incubator follow the directions closely and do not let several members of the family run it; if you do, somebody will make a mistake and upset the whole affair and will be sure to charge it to the other fellow. Select some one in the family to look after the machine, and allow no one else to go near it. The incubator is a success, when one has many eggs to hatch. If only a few, if you can get a good old Plymouth Rock hen, I should rather have the eggs under her than in any incubator ever made. But we cannot trust every hen, particularly the Leghorns. The Plymouth Rock and Wyandottes, however, will stick to the nest all summer.

Question.— When is the best time to start the incubator for exhibition fowl?

Mr. McGrew.— For all Asiatic and American breeds, as soon after December 15th as you can have the eggs; for the smaller breeds, after March 1st.

Question.— Do you prefer brooders to hens in rearing chickens? Why?

Mr. Van Dreser.— We have never lost nearly as many chicks by disease with brooders as we did with hens. We prefer brooders: First, because they save labor; second, because they always tend to business and the chicks are brooded any time that they want to be without having to wait the notion of a fussy hen.

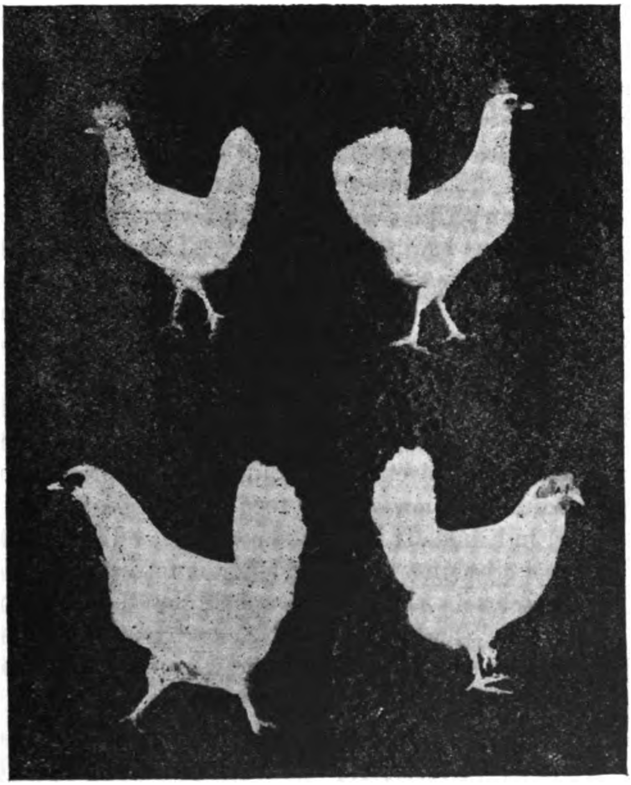
Mr. Jennin.— Hens for small flocks, where only a limited number of chickens are wanted, as it requires less attention and chickens are given more range. Brooders where one intends to make it a business and large numbers of chicks are wanted for early broilers.

THE EGG-LAYING TYPE.

By JAMES E. RICE, YORKTOWN, N. Y.

It is a disputed question whether such a thing exists with fowl as an egg type. My own observation, however, leads me to believe that the best laying fowl do differ from other fowl of the same breed that are not so good layers. They differ in characteristics that are to be recognized by one who is familiar with his fowl. Theoretically, it is perfectly natural and plausible that the pronounced development of certain functions would call for a harmonious structural development of the individual to support this function. For instance, the function of speed is accompanied with lightness of body, high nervous energy, great endurance and pluck and a striking adaptability of size and shape of bone and muscle to do the work demanded with the least waste of energy. In short, it is simply the result of the silent working of the great law of adaptation which has made the pronounced types in all of our breeds. This has been hastened and sometimes hindered by the hand of man. The contrast between the race horse and the draft horse; the milch cow and beef cow; the grayhound and bull dog; the Mediterranean fowl and the Asiatic, is but another evidence of the relation between type and performance. These types do not simply happen so; they have gradually developed to be the best for the purpose. When a hen is born with parts better adapted to egg production than any hen heretofore, she will, with the proper care and food, make the largest record. That sounds like a self-evident truth. It is. So is an egg type. But egg type does not mean body-shape alone. That's where most failures occur in selection. We must remember that shape is only one factor in the productive power of an individual. A hen may be perfect in form and still be a poor producer, because not inheriting a high reproductive tendency; just as a locomotive may be perfectly formed in every part to make great speed, but fail because made of poor metal. Some hens with perfect form and inherited prolificacy to be large egg-producers, may fail on account of lack of vitality and vigor of constitution to withstand the drain upon the system. When, however, all these qualities are combined in one individual, we get the highest production. Such a hen will differ in characteristics which will distinguish her from other hens of the same breed, which are not good layers. She will have the egg-laying type, and tendency to lay.

Most poultrymen who have observed the hens that are found most often on the nest and have been accustomed to selecting their breeding-pens with this end in view, will, I think, agree to the statements that have been made. They can quite accurately separate the best layers from the poorest layers. I suggest that those of my friends who have never before given it a thought, or who do not believe in egg type, try selecting a pen of the best layers this spring, and save their eggs to breed from, and see for themselves whether they do not get a finer lot of laying fowl than they ever had before. The first thing that should be looked to is a fowl that is large and that has a strong constitution, without which all else is for naught.



The two upper fowl in the illustration are of the non-egg-laying type. They are of the wild, flighty, squawking type — narrow, closely-knit, bird-shaped bodies. The two lower fowl are built for business. They are of a less "flighty" disposition, though always active and intelligent. You will observe the long, rangey back, and the extreme depth of body from back to keel, and particularly the large fluff. The whole structure indicates at a glance a large development of the egg-producing machinery, and a great capacity to supply this machinery with digested food. There is a decided effeminate, motherly appearance to a good layer, in direct contrast to the rooster-headed, thick-necked hen. She generally is very active, inquisitive and friendly, which all speaks for great nerve development and intelligence. According to the corelation of parts, she will have a large comb. The condition of the comb is closely related to the strength and vigor of the egg machinery. When it comes to a question of utility, if the standard type disagrees with natural productive type, change the standard. The laws of God are superior to the laws of man.

When selecting the breeding-pens for egg production it is a good plan to mark the fowl which do not meet our idea of a good laying type in size, shape, color and constitutional vigor, with a dab of crimson paint on the shoulders. It makes them look odd, indeed, with their "prison stripes," but it positively prevents their getting in the breeding-pens again undiscovered. This rigid selection for several years has had a wonderful effect upon the quality of our flock, which leads me to believe that there is as much, or more, in the type or particular strain of a breed, as there is difference in the breeds themselves. A man who is careless about selecting — who does not know, or does not care what he is breeding from — will lose in three years what it may have taken a careful breeder many years of painstaking selection to acquire. High production is the result of careful selection, proper feeding and good breeding; all must go hand in hand. It is a made condition. It is like a height gained by hard climbing. The tendency is to revert or drop back to the original level. It is only upheld by the hand of man. Lucky is the man who is wise enough to buy the results of the skill of a good breeder, and wiser is he who maintains the advantage gained and continues to improve upon it.

VETERINARY DEPARTMENT.

Question.— How is the best way to exterminate vermin in a hen house and keep them out?

Mr. Van Dreser.— I should advise removing the whole interior of a hen house and replacing it with new, and stuff the four-inch space between the walls with swale hay or straw to keep the house dry, as vermin thrive in a damp, filthy house. Then keep the house thoroughly clean and apply kerosene oil and carbolic acid to the nests and perches every week. A good dust bath will keep the large body lice from becoming so numerous as to cause much damage.

Question.— Is there any cure for feather-pulling? Why do hens do it?

Dr. Smead.— Yes, before it becomes a confirmed habit. It can be cured. If they pull their own feathers, lice may be the cause, in trying to get the louse. They pull a feather and get a taste of the blood, which their appetite may crave. Get rid of the lice and feed once daily fresh meat run through a chopper. If they pull the other fowls' feathers, they do it for the blood they get, as a rule. Feed them fresh chopped meat. Prepared animal meals will not take the place of chopped fresh meat for this purpose.

Question.— What is the cause and remedy for chickens that have the gapes?

Dr. Smead.— Prevent the gape worm getting in the throat by always setting the chicken coop on a floor or boards, and using lime freely about the place where the coops set, moving them once in a week or at least two weeks. When not too far down the windpipe, the looped horse hair can be used to dislodge them. Turpentine and lard or olive oil and turpentine used equally can be used by dipping a feather in it and swabbing out the throat. This will remove some of them. But a better cure is to prevent.

Mr. Rice.— Gapes are caused by a worm in the throat of the chicken. The remedy is not to allow it to get there, but if it does, it may be snared out with a horse hair, or the chicken may be made to sneeze it out by inhaling some pungent substance, like slaked lime dust. The worm comes from the angle worm in the soil, or from eating food on soil that contains the gape worms. Therefore, the young chicks should be kept on board floors or on new sod. Do not allow them to run there long before the coops are changed, and if gapes have appeared in the flock, do not place the coops on the same ground again.

Question.— What is the cause of hens' becoming blind, and what is the remedy? So far as can be seen, there is no roupy symptom; no swelling; no effusion; the general health of the fowl is good.

Dr. Smead.— Either catarrhal disease will cause the blindness, or sometimes an inflammation will take place from ammoniacal gases in a hen house from bad ventilation. Make all surroundings in the best possible condition; mix olive oil and strained honey together equally and put a drop with a camel's hair pencil in the eye two or three times daily.

Question.— What about condition powders for hens?

Dr. Smead.— The best condition powders I know are good, well-balanced rations. What is the matter with your hens?

The Farmer.— I suppose it is roup.

Dr. Smead.— Probably the best way to treat a hen thus afflicted is to cut off its head and bury it. Watch the hens, and if you find one that is ailing, take it away from the flock. You may use a camel's-hair brush, and with a mixture of vaseline and alcohol anoint the throats of the sick hens. But the best way is to make the sanitary conditions good. Prevent dampness, give good rations and make the hen house warm and light. Unless there is disease in the flock or herd, don't give medicine. As a rule, roup and kindred hen diseases do not appear in the flocks in summer, when they are out. Another point; don't feed too much carbonaceous foods, such as corn, in winter. If the hens are to lay eggs, they must have protein; not only for egg production, but to keep in a well-balanced way the animal structure. I should not buy a pound of these so-called "condition powders." They have a basis of linseed meal, which costs now about $23 per ton; but the powders are sold for about $400. There is a little golden seal, powdered aniseed, and something else to make the mixture smell good, as well as palatable, to the hen. That is all. Don't buy them for any purposes.

Question.— What is the cause of hens' having a "gagging" in their throats?

Dr. Smead.— If it is a chicken, I should think it was the work of the gape worm. If it is an adult hen, possibly it is diphtheria. Syringe or brush the membrane of the throat, using alcohol and vaseline, making two or three applications a week, first quarantining the sick fowl.

Question.— Will you please describe the disease known as blue-head in young turkeys; give the cause, method of prevention and cure?

Dr. Smead.— Blue-head is simply an indication of a fevered system. The turkey is the worst fowl known to treat for any disease. Feed on laxative food and let nature do what she can.

Question.— What is wrong with my chicks? Both hen-hatched and incubator chicks are dropping off the same way. They seem all right when hatched, but begin to have fits, and die after they are about a week old. Some are pasted up behind, and some void whitish slimy droppings, and chirp as though it hurt to pass them. Nearly all will fall down in a fit if startled, or even when running about the pen. In the fit, they stretch out with heads back or with wings and feet cramped. Sometimes they gasp and pant. They don't look right when they don't have these spells, and they walk wobbly as though their legs were stiff in the joints. Some have their legs and feet all dried up and the toes drawn up. I am feeding them and caring for them just as I have always done with chicks before, and this is my first "bad luck" season. Can you set me right?

Dr. Smead.— The fact of their being hatched strong and free from the ailments which follow when a week of age shows quite conclusively that there is some condition along lines of your feeding and management that brings on the trouble. The bowel trouble by the food and the rheumatics by dampness or crowding, or by sudden change or an improper temperature of your brooder. In order to offer definite advice, I should have to know what present conditions are. But will say, make a change in your feeding, at any rate; while it may have been successful under past conditions, it may be all wrong now; also, if not what you believe to be right, change the conditions in the brooder.

The following questions were answered by Dr. Mark D. Williams.

1. Is there any known remedy for "going light" in fowl?

Answer.— Yes. The disease is caused by a germ (*bacteria*). The disease manifests itself by the fowls' becoming dull, with great loss of flesh and weight, a tottering gait, good appetite, increasing weakness, and death in a few days or a month, and is more aggravated by damp weather. It is much like bacterial enteritis and cholera, but there is little or no diarrhœa. R. Treatment for half-grown fowl: Hyposulphite of soda, 2 grains; sulphate of iron, 1 grain; oxide of iron (venetian red), 30 grains. If there is diarrhœa, add subnitrate of bismuth, 1 grain. Mix and give in feed, or in pill, morning and night. Great care should be taken not to make a mistake and give oxide of lead (red lead) as it is a deadly poison.

2. (*a*) What is roup? (*b*) Is it contagious? (*c*) How can it be prevented? (*d*) How cured?

Answers.— (*a*) Roup is a word used to signify (catarrh) an inflammation in the upper air passages, sore throat, change of voice, and a *mucous nasal discharge*, as these symptoms appear in simple catarrh, infectious catarrh, diphtheria, "going light," bacterial enteritis and psorospermic enteritis, it will be seen that the word "roup" should not be used as the name of a disease, as it is confusing. (*b*) All but the first one named are infectious. (*c*) To prevent infectious catarrh and diphtheria, fowl should not be brought home from the show, nor be taken from unknown flocks and placed with the home flock for at least two weeks, and it is not even safe to allow the same person to care for them that has charge of the home fowl; people or animals should not be allowed to come from infected flocks and go directly to the healthy flock. I have had good success in preventing psorospermic enteritis, bacteria enteritis and going light by feeding hyposulphite of soda, sulphate of iron and oxide of iron once a week. In damp weather these diseases are more virulent. Chicks or fowl should never have wet feet nor be kept in damp places. (*d*) In speaking of the cure for these diseases it may be well to say that one dose for an adult fowl will make one dose for 20 little chicks one week old. Simple catarrh, or simple cold, usually affects but one or two fowl at a time and they soon recover. With infectious catarrh, a good share of the flock have it at the same time, and the eyes swell. In turkeys the nasal sinuses also swell or enlarge. R. Treatment: Put two ounces of permangante of potash (or boric acid, but not as good), in four quarts of water, grasp the fowl in one hand and the neck in the other and submerge the head three or four times until the bird is about strangled each time, and do this once a day for a week; take one-half ounce of permanganate of potash and put it in four quarts of water and give them this to drink for a week. Diphtheria is a disease where cankers are found in the mouth, and the treatment is the same as for infectious catarrh. Psorospermic enteritis is a disease that causes great loss in young chicks. There is usually diarrhœa, with whitish excrement, followed by constipation; with adult fowl, diarrhœa is abundant and the excrement may be of a brick-red color, or even streaked with blood. Treatment the same as for "going light," with a little charcoal and chalk. Bacterial enteritis, a disease causing great loss in chicks, turkeys and ducks, much like "going light," but with no appetite and diarrhœa. Treatment the same as for psorospermic enteritis.

3. Is there any cure for chicken cholera?

Answer.— Yes. It is, however, a very uncommon disease. Place the fowl in a small pen, remove the droppings and sick birds once a day and disinfect the floor; feed in clean dishes and treat the same as for "going light" for a week or ten days.

4. Is there any cure for blackhead in little turkeys?

Answer.— I have had good success in treating them the same as for bacterial enteritis. If the caeca and liver are found diseased, that is, the caeca shortened and thickened and the liver with spots on it, it will be a good idea to start with a new flock, or dispose of the old ones before the eggs hatch that are under hens, and put the young turkeys on new ground for a time.

THE COMPOSITION AND USE OF FERTILIZERS.

By L. L. Van Slyke, Ph. D., Chemist, N. Y. Agricultural Experiment Station, Geneva, N, Y.

Part I.—Chemistry of Plants, Plant Foods and Soils.
Part II.—Classification and Description of Materials Used as Fertilizers.
Part III.—Purchase and Use of Fertilizers.
Part IV.—Arithmetic of Fertilizers.
Part V.—Average Composition and Value of Fertilizing Materials and of Farm Crops.

INTRODUCTION.

The matter in this treatise is to be carefully studied, not merely read, if one expects to obtain the greatest benefit from it. It is suggested that the bulletin be taken up in small portions at a time and be studied constantly, going back to parts previously studied until they are clearly understood. Many may find that Part I especially will need to be studied in this way and it may be well to pass on to the following portions and come back to Part I from time to time. In this way its importance will be more fully realized and also its connection with the other parts. The bulletin should be kept at hand for constant reference.

Until 50 years ago, agriculture was without a scientific working basis. To the investigations of the illustrious German chemist, Justus von Liebig, we largely owe the advances that have been made in agricultural methods during the past half century. The following four laws, which form the foundation of modern agricultural practice, were fully established by Liebig:

1. "A soil can be termed fertile only when it contains *all the materials requisite for the nutrition of plants,* in the required quantity, and *in the proper form.*"

2. "With every crop, a portion of these ingredients is removed. A part of this portion is again added from the inex-

haustible store of the atmosphere; another part, however, *is lost forever if not replaced by man.*"

3. "The fertility of the soil remains unchanged, if all the ingredients of a crop are given back to the land. Such a restitution is effected by *manure.*"

4. "The manure produced in the course of husbandry is *not* sufficient to maintain permanently the fertility of a farm; it lacks the constituents which are annually exported in the shape of grain, hay, milk and live stock."

These four laws of Liebig contain a clear statement of the principles underlying the use of fertilizers; but, to understand their meaning with satisfactory clearness, we must know something more in detail about such subjects as the following: The constituents of plants; the materials of plant food; the constituents of soils; the relations of soils and plants; the sources and composition of different forms of plant food; what forms and quantities of plant food to use on different soils and crops, and other similar questions.

PART I.

THE CHEMISTRY OF PLANTS, PLANT FOODS AND SOILS.

1. THE CONSTITUENTS OF PLANTS.

Elementary Composition of Plants.— The number of different kinds of plants growing on the earth is estimated at not less than 200,000; and these, with all their variation of stem, foliage, flower and fruit, are made from about a dozen different chemical elements. Indeed, the greater proportion of the bulk of the vegetable kingdom is made from only three different elements.

By a *chemical element,* we mean *any substance which cannot, by any known means, be separated into two or more different kinds of matter.* Thus, oxygen is an element because it contains only one thing, oxygen, so far as we now know. From pure gold, nothing but gold can be obtained; hence, gold is an element. Similarly, nitrogen, carbon, phosphorus, sulphur, iron, etc., are elements.

At present about 70 different elements are known, and of these 70 only 14 are used in the production of plants; while of these 14, only 11 or 12 are really essential to plant growth. The following list contains the names of elements that occur in plants: Carbon, oxygen, nitrogen, hydrogen, potassium, phosphorus, calcium, magnesium, sulphur, iron, chlorin (sodium, silicon, manganese).

These few elements we may regard as a kind of chemical alphabet of the vegetable world. We do not find these elements simply tumbled together in miscellaneous heaps in the formation of plants. Somewhat as the letters of our alphabet unite to form words, so the chemical elements are united to form various chemical compounds, and these compounds are mixed together in a variety of ways to form plants.

Classes of Chemical Compounds in Plants.— It will be of interest in passing to notice briefly some of the more common kinds of chemical compounds found in plants:

1. There is a most important and extensive group of compounds, each containing carbon, hydrogen and oxygen. The class, as a whole, is known by the name of *carbohydrates*. The most common members of this class are sugar, starch, woody fiber, vegetable gums, etc.

2. We have another class distinguished for the valuable food constituents contained in it, known in general as *proteids*. As a representative of this class, we may mention the gluten or sticky portion of wheat flour. This contains beside the three elements of carbohydrates, three other elements — nitrogen, phosphorus and sulphur.

3. We have the vegetable oils, from which come our linseed, castor, olive, cotton seed, and other vegetable oils of commercial importance.

4. We may mention as another class the vegetable acids — for example, the tartaric acid of grapes, present as a compound of tartaric acid and potassium, containing the elements carbon, hydrogen, oxygen and potassium; citric acid, found in lemons, currants, cherries, strawberries and similar fruits; malic acid, in apples, etc.

5. We have that extremely important class of compounds which give characteristic flavors to many plant products, particularly the flowers and fruits.

6. There may be mentioned in passing the very widely distributed substances of vegetable origin, used for medicinal purposes, such as quinine, morphine, strychnine, etc.

The exact number of different compounds in the vegetable kingdom formed from our dozen elements is not known but must be very large, as can be inferred from the character of the few referred to.

Classification into Air-Derived and Soil-Derived Elements.—The elements necessary to the growth of plants may be divided into two quite distinct classes, which have important and marked differences. These two classes are: (*a*) Air-derived elements. (*b*) Soil-derived or mineral elements.

(*a*) *Air-Derived Elements.*

Carbon,
Oxygen,
Hydrogen,
Nitrogen.

(*b*) *Soil-Derived Elements.*

Potassium,
Phosphorus,
Calcium,
Magnesium,
Sulphur,
Iron,
Chlorine,
Sodium,
Silicon,
Manganese.

It is usual among writers on agricultural chemistry to call these classes organic and inorganic elements, but this use of these words is extremely inaccurate; for any element may be either organic or inorganic, according as it is or is not a part or product of an organized body. Oxygen, as it exists in the air, is inorganic matter; but when, through vital processes, it becomes part of an animal or plant, it is organic.

These two classes of elements differ in three important particulars, as follows:

1. The elements of the first class are derived exclusively from the air, either directly or indirectly; while those of the second class come exclusively from the soil.

2. Air-derived elements disappear, for the most part, in the form of gases, when a plant is burned; while the soil-derived elements, usually the smaller part, are left in the form of a residue or ash, upon which further heating will not have any effect. Some carbon and oxygen and nitrogen are always found in the ash, while slight quantities of chlorine, sulphur and phosphorus are apt to be driven off by heating. The two classes of elements are, therefore, not so sharply defined in this regard as they are in respect to the sources from which they come.

3. These two classes differ very noticeably in regard to the

quantities in which they are present in plants. Thus, *the air-derived elements constitute, at least,* 95 *per cent. of the whole vegetable kingdom,* while the soil-derived elements occur in small quantities, varying from a fraction of one per cent. up to 10 per cent., or even more in some cases. Because the soil-derived elements occur in small quantities, it does not follow that their presence is of less importance; in their absence, vegetation would disappear.

This fact has a most important application in enabling us to control our yield of crops. Man cannot, to any appreciable extent, at least economically, control directly most of the air-derived elements in feeding plants; but he can do so indirectly through the soil-derived elements. In other words, by looking after less than five per cent. of the materials used by plants as food, he can, to a large extent, control the other 95 per cent., other conditions being favorable.

We will now consider some of the properties of the different elements that enter into the composition of plants.

CARBON.

(*a*) *Importance.*— The element carbon may be called the central element of all animal and vegetable substances; for there is not a living thing, from the smallest cell to the giant tree, which does not contain carbon as a necessary constituent. That all vegetable and animal substances contain carbon can easily be shown by simply heating them sufficiently, and thus causing them to *blacken* or *char.* When, for example, wood is heated, the different elements of which it is composed are driven off in one form or another, but the carbon is the last to go, and remains behind as a black substance or charcoal, unless heated higher, when it disappears or burns up.

(*b*) *Source.*— Carbon usually occurs in nature united in compounds with other elements. Thus, most products of plant life contain carbon combined with the elements hydrogen and oxygen; such are starch, sugar and cellulose or woody fiber. Carbon combined with oxygen occurs in the air in the form of carbon dioxide, commonly called carbonic acid gas. Carbon, when combined with oxygen and some elements such as calcium, occurs in the form of carbonates; for example, marble, limestone and chalk are chemically known as calcium carbonate or carbonate of lime.

Carbon by itself or in the free condition, that is, not united with any other elements, is familiar to us in several different forms; the most common of these are (1) diamonds; (2) graphite, which is used in the manufacture of lead-pencils; (3) ordinary wood-charcoal; (4) lamp black; (5) animal charcoal; (6) mineral coal. Excepting diamond these forms of carbon are more or less impure, containing some other things mixed with the carbon.

(*c*) *Relation to Fertilizers.*— We know that carbon must be an important element in plant food, since it forms nearly one-half of the solid portions of plants. Notwithstanding the fact that carbon forms so large a portion of plants, it has no importance as an *active* food constituent of *direct* fertilizers. This statement may appear strange and the question may be asked, "why is not carbon to be regarded as an essential constituent of direct fertilizers?" The answer is that the carbon of plants comes from the carbon dioxide (carbonic acid gas) of the air, and the air furnishes an inexhaustible and available supply of this substance. We do not, therefore, need to add carbon to the soil in order to supply the needs of plants. However, some recent investigations seem to indicate that some carbon is probably taken into the plant through the roots and that forms of carbon other than carbon dioxide may be found to be useful in supplying plants with their carbon food.

Carbon dioxide is present in the atmosphere to the extent of three parts in 10,000 parts of air. Though present in so small proportions, we have in the atmosphere resting upon one acre of ground more than 20 tons of this gas, an amount sufficient to supply 16 times as much carbon as any crop would ever be likely to need. The supply of carbon dioxide in the air is kept up by the burning of fuel, from the breath of all animals, and from the natural processes of decay of organic matter. A ton of good coal, in burning, produces over three tons of carbon dioxide. The people in a town of 10,000 inhabitants breathe out every twenty-four hours not less than five tons of carbon dioxide. This amount would furnish enough carbon to grow several acres of corn with an extremely large yield.

Carbon dioxide performs a service for plants in another way when it is carried into the soil in rain water, by means of the dissolving action it has upon some of the mineral plant food constituents of the soil. In this way it acts as indirect fertilizer.

(*d*) *Specific Functions in Plant Growth.*— Carbon is a constituent of nearly all the compounds, except water, found in plants, such as starch, fibre, sugar, fat or oil, proteids, acids, etc. Hence, its function is to supply its necessary part of the material found in such compounds. Plants take in their supply of carbon dioxide chiefly through their leaves directly from the surrounding air. In the cells of the leaves, the carbon dioxide, in the presence of sunshine, is separated into its elements, its carbon uniting with other elements to form various compounds, such as starch, sugar, woody fiber, etc., the oxygen being largely returned to the air as free or uncombined oxygen.

HYDROGEN.

(*a*) *Source.*— The element hydrogen is nearly always found combined with other elements. It combines with oxygen to form water. Hydrogen also occurs in most animal and vegetable substances, such as various kinds of wood, fruits, etc., in which it is combined with the elements, carbon and oxygen. Hydrogen is always present in all kinds of acids.

(*b*) *Description.*— Hydrogen, in the uncombined form, is a gas that resembles air in that it has neither color, smell nor taste.

(*c*) *Relation to Fertilizers.*— Hydrogen, as a constituent of water has most important work in plant nutrition, and this will be considered a little later.

(*d*) *Specific Functions in Plant Growth.*— This is considered under the subject of water.

OXYGEN.

(*a*) *Source.*— Oxygen is the most abundant of all the elements. The compounds which contain no oxygen are few in number. Oxygen forms nearly one-half of the crust of the earth; eight-ninths of water; about one-fifth of air, and one-third of all animal and vegetable matter.

Oxygen occurs in the air uncombined with other elements. Oxygen, combined with the elements carbon and hydrogen, or with carbon, hydrogen and nitrogen, is found in substances which go to make up animals and vegetables.

(*b*) *Description.*— As might be inferred from knowing that oxygen in the uncombined state forms part of the air, oxygen is a gas having no color, taste or smell.

Oxygen is a very active substance from a chemical point of view. It tends to unite with nearly all of the elements. In all forms of burning, the oxygen of the air is simply uniting with other elements. Thus, in a coal fire, the oxygen unites with the carbon of the coal. The heat is produced by the union of the two elements.

(c) *Relation to Fertilizers.*— The oxygen which plants use comes largely from the air, of which it constitutes about one-fifth, and this amounts to about 10,000 tons an acre. Some of the oxygen that plants use for tissue formation and elaboration of plant compounds is supplied in the form of water, which is a compound of oxygen and hydrogen.

Water (Hydrogen and Oxygen).— Growing plants consume a larger amount of water than of any other compound. More or less water is separated within the plant into its constituent elements, hydrogen and oxygen, and these are then built into the tissues and compounds which it is the office of the plant to elaborate. In this manner, water acts as a *direct fertilizer.* The water is supplied to the soil by rains, and from the soil it is taken into the plant through the delicate root-hairs. Most of the water that enters a plant through the roots is evaporated finally from the leaves into the air as water vapor, this process being known as *transpiration.* The amount of water transpired into the air is immensely greater than that retained in a plant. Some plants exhale their own weight of water during 24 hours in hot, dry weather. A crop of barley grown on an acre of land may weigh 5,000 pounds, grain and straw included. Of this there will be 500 pounds of water and 4,500 pounds of dry or solid matter, to produce which the crop has evaporated from the growing plants during their period of growth not less than 700 tons of water, an amount of water which would require a railway train of 35 cars to carry. *Under average conditions, 300 pounds of water will have to pass through a plant into the air, while one pound of solid matter is being added to the plant.* The need for enormous quantities of water in growing crops is obvious, but, in regions adapted to agriculture, plants usually receive from rain all the water (oxygen and hydrogen) needed. Hence, these plant food elements do not usually enter into a farmer's consideration, when he is planning to supply his crop with needed plant food. However, it is essential that the losses of water from the soil shall be controlled, as can be done by proper means of tillage, keeping up supply of humus, etc. When water is supplied to plants by irrigation, it is very properly regarded as a fertilizer, and an extremely important one.

(*d*) *Specific Functions in Plant Growth.*— Oxygen, next to carbon, is the most abundant element found in plants, and there are very few compounds occurring in plants which do not contain more or less oxygen. The chief function of oxygen is to supply the various compounds of plants with the needed portion of this material. Plants require oxygen about as much as do animals. Green plants cannot flourish without a supply of oxygen. The absence of oxygen prevents the germination of seeds. Considerable quantities of oxygen are absorbed from the air by the opening buds of trees. More or less oxygen in the soil is necessary for the active life of roots. In the act of flowering, the absorption and chemical action of oxygen in the blossom is so marked, in some cases, as to develop sufficient heat to be measured by a thermometer.

Water (*Hydrogen and Oxygen*).— In the combination of oxygen with hydrogen in the form of water, these two elements perform important functions. In the first place, nearly all the hydrogen found in the different compounds of plants comes from water. More or less of the oxygen is also supplied this way. In addition to furnishing materials with which to build other compounds, water acts as a carrier within the plant in transferring from one part of the plant to another, as needed, the various products contained in the plant, just as the blood in the animal body carries to every portion the nutriment adapted to each organ and part.

NITROGEN.

(*a*) *Source.*— Nitrogen occurs in nature in the following forms:

(1) As a constituent of *air.*
(2) In the form of *ammonia.*
(3) In the form of nitric acid and *nitrates.*
(4) In various other forms in plants and animals.

(1) NITROGEN IN AIR.— Nitrogen, uncombined with other elements, forms about four-fifths of the air. Since the nitrogen in the air is not combined, we can perceive its properties for ourselves, and our observation shows us that it is a gas, which has neither color, taste nor smell.

(2) NITROGEN IN AMMONIA.— Nitrogen combined with the element hydrogen forms ammonia. Ammonia is present in the air in very small quantities. Ammonia is formed when vegetable and animal substances containing nitrogen decompose.

Ammonia is a colorless gas, and it is this gas dissolved in water which is familiar to us as ammonia water or "Spirits of Hartshorn," and which causes the peculiar odor of "hartshorn."

Ammonia unites with different acids and forms salts somewhat as metals do; these salts we call *ammonium salts,* compounds which do not generally have any odor like ammonia. Thus, ammonia combined with sulphuric acid forms *ammonium sulphate,* commonly called sulphate of ammonia; ammonia, combined with hydrochloric acid, forms *ammonium chloride,* sometimes called muriate of ammonia, also known as *sal ammoniac.*

(3) **NITROGEN IN NITRATES.**— Nitrogen, combined with hydrogen and oxygen, forms *nitric acid* or *aqua fortis.* If in nitric acid a metal as sodium, for example, takes the place of hydrogen, we have formed a sodium salt of nitric acid or a *nitrate,* called sodium nitrate, or nitrate of soda.

When animal and vegetable substances decompose in rather warm, moist places, the nitrogen is changed into nitrates. This change of the nitrogen of organic matter into nitrates is caused by germs called *bacteria,* which are very small living vegetable organisms, and which exist everywhere in enormous numbers. The process is known as *"nitrification."*

(4) **NITROGEN IN ANIMALS AND PLANTS, OR ORGANIC NITROGEN.**— Nitrogen, combined with the elements, hydrogen, carbon and oxygen occurs in plants and in animals. Such substances for example are the casein or curd of milk, the gluten or gummy portion of wheat, the fibrin of blood, the white of egg, etc. When such compounds decompose, the nitrogen is first changed into ammonia, and then, under proper conditions of warmth, moisture and access of air, into nitric acid or nitrates. The nitrogen existing in animals and plants is generally called *organic nitrogen.*

(*b*) *In what Forms Nitrogen is Useful to Plants.*— Plants can use nitrogen in three different forms, viz.:

(1) As nitrogen gas or uncombined nitrogen.
(2) In the form of ammonia.
(3) In the form of nitrates.

All plants cannot use nitrogen in any of these three forms equally well, but each form is found specially suited to certain kinds of plants as will be noticed.

(1) **NITROGEN GAS USED BY PLANTS.**— Although we have nitrogen gas or uncombined nitrogen existing in the air in enormous quantities, still the number and kinds of plants which can use the

nitrogen of the air is not large. In general, those plants which are called *leguminous,* such as the bean, pea, clover, alfalfa, etc., can take uncombined nitrogen from the air.

(2) NITROGEN OF AMMONIA USED BY PLANTS.— The leaves of some plants have the power of absorbing ammonia directly from the air and obtain nitrogen in this way, but only in very small quantities. Some plants obtain nitrogen from ammonium salts through the soil, but in general, the compounds of ammonia are changed into nitrates in the soil before being used by plants.

(3) NITROGEN OF NITRATES USED BY PLANTS.— The largest part of the nitrogen obtained by most plants is taken up by their roots from the soil *in the form of nitrates;* that is, nitric acid combined with some metal, as sodium or potassium. As already stated, most of the nitrates used by plants are formed by changing into nitrates ammonia compounds and organic substances in the soil by the process called *nitrification.* Hence, *nitrogen, in the form of nitrates,* is the most *available* form for most plants; that is, it can be most readily taken up and used by plants.

(*c*) *Relation to Fertilizers.*— Experiments have shown that *nitrogen* is essential to the growth of plants; that the quantities of nitrogen available as plant food are very small; that nitrogen is one of the first elements in the soil to be used up; that, of all fertilizing elements, nitrogen is and always has been the most expensive.

(*d*) *Specific Functions in Plant Growth.*— The influence of nitrogen in its various forms upon plant growth is shown by at least three striking effects.

1. The growth of stems and leaves is greatly promoted, while that of buds and flowers is retarded. Ordinarily, most plants, at a certain period of growth, cease to produce new branches and foliage, or to increase those already formed, and commence to produce flowers and fruits, whereby the species may be perpetuated. If a plant is provided with as much available nitrogen as it can use just at the time it begins to flower, the formation of flowers may be checked while the activity of growth is transferred back to and renewed in stems and leaves, which take on a new vigor and multiply with remarkable luxuriance. Should flowers be produced under these circumstances, they are sterile and produce no seed.

2. The next effect of nitrogen upon plants is to deepen the color of the foliage, which is a sign of increased vegetative activity and health.

3. Another effect of nitrogen is to increase in a very marked degree the relative proportion of nitrogen in the plant. This is something which we cannot see with our eyes and which can be ascertained only by chemical analysis. The importance of this fact may not be readily apparent, but it becomes so, when we consider that much of the value of some foods depends upon the amount of nitrogen compounds, that is, *proteids,* contained in them. For example, some samples of wheat may contain only eight per cent. of proteids, while others may contain twice this amount. This difference in composition makes a great difference in food value.

PHOSPHORUS.

(*a*) *Source.*— Phosphorus is always found in nature combined with other elements. It occurs combined with oxygen and calcium (or lime) and this compound is called *calcium phosphate* or *phosphate of lime.* It also occurs in soils as phosphate of magnesia, and phosphate of alumina and iron. Calcium phosphate or phosphate of lime is found in some minerals and in the bones of animals.

(*b*) *Description.*— Phosphorus, when uncombined with other elements, it is yellowish, waxy-looking, solid substance. It is soft and can be cut as easily as ordinary beeswax. It is very poisonous. It takes fire very easily and, therefore, has to be kept under water. When phosphorus burns, it simply unites with the oxygen of the air, forming a compound which contains oxygen and phosphorus; this compound of oxygen and phosphorus is commonly called phosphoric acid.

(*c*) *Importance of Phosphorus Compounds.*— The phosphates, like the nitrates, are found everywhere in the soil and are of great value in their relations to plants. The phosphates found in the bones are taken into the animal body in the food. All plants used as food contain small quantities of phosphorus compounds which they get from the soil. The phosphates taken into the body are partly given off in the excrement and urine.

(*d*) *Relation to Fertilizers.*— The fact that phosphorus compounds are absolutely necessary for the maturity of plants indicates that phosphates are essential to complete fertilizers. Soils become deficient in available phosphates quite rapidly, especially in grain-growing regions.

(*e*) *Specific Functions in Plant Growth.*— 1. Phosphorus compounds aid in the general nutrition of the plant by furnishing such quantities of phosphorous as are needed in building proteids and in forming other phosphorus plant compounds.

2. Phosphorus affects the development of seeds and fruit. More phosphorus is found in the seeds than in any other portion of a plant. Plants do not come to maturity and so do not produce seeds, unless the plants can get phosphorus compounds to feed on. Owing to the intimate connection between phosphorus and seed formation, a liberal application of available phosphorus compounds to plants in the earlier stages of growth appears to hasten somewhat their maturity. In this respect, it acts upon plants in a manner opposite to nitrogen, whose presence in large amounts retards ripening.

3. Certain forms of phosphates render the proteids sufficiently soluble to enable them to be carried from the growing parts of plants to the seeds, in which they accumulate in quantity.

POTASSIUM.

(*a*) *Source.*— The metal potassium is never found uncombined in nature. It is a constituent of many minerals. The decomposition of these minerals give rise to the presence of potassium compounds everywhere in the soil. It is taken up by plants; and when vegetable material is burned, the potassium remains behind, chiefly as potassium carbonate. When wood ash is treated with water, or "leached," the potassium carbonate is dissolved out, forming "lye," and this, evaporated to dryness, leaves impure potassium carbonate, which is commercially known as *potash*.

In using the term *potash* in connection with fertilizers, potassium oxide is always meant. The compounds of potassium are commonly called *potash compounds,* because it was formerly supposed that potassium oxide or potash was present in all of them.

Potassium combined with chloride forms potassium chloride or chloride of potash or *muriate of potash,* etc. Potassium and sulphuric acid form potassium sulphate or *sulphate of potash.* Potassium and nitric acid form potassium nitrate, also called *nitrate of potash and saltpetre.*

(*b*) *Relation to Fertilizers.*— Experiments show that when potassium (or potash) compounds are lacking in the soil, the plant suffers greatly, though it does not necessarily die. The development of the woody parts of plants and the fleshy portions of fruits seems to be largely dependent on the influence of potassium compounds. As potash is taken up by vegetation, most soils under constant cultivation sooner or later become deficient in potash, and this loss must be supplied by means of fertilizers. Therefore, potassium (potash) compounds are regarded as essential constituents of direct fertilizers.

(*c*) *Specific Functions in Plant Growth.*— Potassium compounds are instrumental in performing several different functions in the economy of plant life.

1. Potash compounds are essential to the formation and transference of starch in plants. Starch is known to be first formed in the leaves of plants, after which in some way it becomes soluble enough within the plant cells to enable it to pass through the cell walls gradually and later to be carried into the fruit, where it accumulates and changes back to its insoluble form. It is well established that potassium compounds are intimately connected with the formation of starch in the leaves and with its transference to the fruit. No other element can take the place of potassium in performing this work. For the carrying of starch a minute amount of calcium (lime) and chlorine appears to be needed in addition to the potassium.

2. Potassium compounds are important because they exercise a marked influence upon the development of the woody parts of stems and the fleshy portions of fruit.

3. We have already stated that the formation and transference of starch is more or less dependent upon potassium compounds present in the plant. Now, this formation of starch and transference to the fruit are preliminaries in the production of sugar, which contributes so much to human enjoyment.

4. Potassium compounds are present in those plant juices, which are rather sour; in these cases, the potassium is combined as an acid salt with such acids as citric, malic, tartaric, oxalic and other acids.

5. Potassium compounds appear to be essential in the formation of proteids.

The functions of the element potassium cannot be performed by the element sodium and *hence sodium cannot take the place of potassium in feeding plants.*

CALCIUM.

(*a*) *Source.*— The metal calcium is always found in nature combined with other elements. The compounds of calcium are ordinarily known as *lime* compounds, because calcium, when combined with oxygen to form a compound known as calcium oxide, was called lime, and this calcium oxide or lime was supposed to be present in calcium compounds.

Calcium combined with oxygen and carbon forms a compound which is known as *calcium carbonate* or *carbonate of lime*. Limestone, marble, chalk, eggshells and coral consist of calcium carbonate or carbonate of lime. Calcium and sulphuric acid form a compound known as *calcium sulphate* or *sulphate of lime;* gypsum and plaster of paris are familiar forms of calcium sulphate; it is often called simply "*plaster.*"

Calcium combined with oxygen, as already noted, forms calcium oxide, which is commonly known as *lime* or *quicklime*. This is made by burning some form of calcium carbonate, as limestone, oyster shells, coral rock, etc.; the carbon dioxide (carbonic acid) is driven off by the heat, and calcium oxide or quicklime remains.

When quicklime is exposed to the air, it slowly absorbs moisture and carbon dioxide and is changed back into calcium carbonate. When quicklime is changed into calcium carbonate (carbonate of lime), the lime is said to be *air-slacked.*

(*b*) *Relation to Fertilizers.*— All plants require calcium, or as it is more commonly called, lime. While many soils appear to contain an inexhaustible supply of lime compounds, there is quite often need of special attention to this element of plant food; rather more, in fact, than was formerly believed necessary.

(*c*) *Specific Functions in Plant Growth.*— Calcium forms a part of several compounds found in plants. Its chief function appears to be that of strengthening cell walls. It is often found united with different acids forming calcium (or lime) salts. Thus, in beet leaves, we find the salt calcium oxalate. In what specific ways it otherwise affects the growth of plants, we do not yet know definitely.

MAGNESIUM.

(*a*) *Source.*— Magnesium is found in several common compounds present in the soil. Magnesium appears to form an essential constituent of plants.

(*b*) *Relation to Fertilizers.*— While magnesium is regarded as a necessary constituent of plants, it does not often need to be added to the soil artificially so far as our present knowledge goes. There are some magnesium compounds existing, as impurities in the German potash salts, and when these latter are used, some magnesium is incidentally added to the soil.

(*c*) *Specific Functions in Plant Growth.*— While magnesium closely resembles calcium in many ways, it cannot replace in plant nutrition. Magnesium accumulates in seeds, flowers, roots and tubers to a much larger extent than it does in straw, stems, leaves and wood, while the reverse is true of calcium. Hence magnesium compounds are especially important in the formation of seeds. In the absence of calcium compounds, magnesium compounds may act as poisons in the plant. Magnesium appears to be associated with nitrogen compounds in the formation of proteids, and it also appears to have some effect upon the formation of the green coloring matter of plants (the chlorophyll).

SULPHUR.

(*a*) *Source.*— Sulphur, uncombined with other elements, is found near volcanoes. Combined with other elements, sulphur is found in a great many minerals. Sulphur is also found in vegetable and animal products, combined with the elements carbon, hydrogen and nitrogen. The properties of the element sulphur are too well known to need any description.

(*b*) *Compounds.*— When *sulphur* is combined with *hydrogen* and *oxygen* in certain proportions it makes *sulphuric acid,* commonly called *oil of vitriol.* When the hydrogen of sulphuric acid has its place taken by any metal, a *sulphate* is formed. For example, when the metal potassium takes the place of the hydrogen of the sulphuric acid, a salt is formed known as *potassium sulphate,* commonly called *sulphate of potash;* from sulphuric acid in the metal calcium is formed the salt *calcium sulphate,* commonly known as *sulphate of lime* or *gypsum.*

(*c*) *Relation to Fertilizers.*— Sulphur is known to be an essential constituent of plant food. So far as known, plants take it up and use it in the form of sulphates. As a rule, there appear to be in all soils amounts of sulphates sufficient to supply indefinitely all the demands of crops. As the quantity of sulphur used by plants is very small, soils do not readily become exhausted of this element. Therefore, we do not need, in general, to add sulphur compounds to the soil. Calcium sulphate (sulphate of lime) and potassium sulphate (sulphate of potash) are often present in commercial fertilizers, but they are generally used not on account of the sulphur they contain. Some forms of sulphur compounds render a soil barren, when present in any considerable quantity.

(*d*) *Specific Functions in Plant Growth.*— Sulphur is required by plants in order to produce the proteids and many of the vegetable oils and characteristic flavors, such as those contained in horseradish, mustard, turnips, onions, etc.

IRON.

(*a*) *Source.*— Iron in various forms of combination is a constituent of all agricultural soils.

(*b*) *Relation to Fertilizers.*— As a rule, iron compounds rarely need to be supplied to plants by artificial application, because they are used only in minute quantities by plants, and agricultural soils contain abundant quantities. However, though used only in very small amounts by plants, iron compounds are absolutely essential to satisfactory plant growth.

(*c*) *Specific Functions in Plant Growth.*— Iron compounds are necessary for the production of chlorophyll in plants. Without iron compounds in the plant no chlorophyll is formed; without chlorophyll, there will be no formation of starch and little vegetative activity of a normal character.

CHLORINE.

(*a*) *Source.*— Uncombined chlorine is never found in nature. We commonly know chlorine only in its compounds. Chlorine combined with hydrogen forms hydrochloric or muriatic acid. Chlorine combined with any metal forms *chlorides* commonly known also as *muriates.* For example, *chlorine* combined with the metal *sodium* forms a compound which is called *sodium chloride* or chloride of sodium, or muriate of soda; and this sodium chloride is the common salt familiar to us in every day experience. *Chlorine* combined with the metal *potassium* forms *potassium chloride* commonly called *muriate of potash.*

(*b*) *Description.*— Chlorine, when not combined with other elements, is a greenish-yellow gas, having a very suffocating odor. The gas is very poisonous and has very active chemical power.

(*c*) *Relation to Fertilizers.*— While chlorine is known to be an essential constituent of plant food, at least with many or most plants, the circumstances which require its addition to the soil appear extremely rare, except in some cases where it may be used for an indirect benefit. It is added to fertilizers in considerable quantities in the form of potassium chloride (muriate of potash) but this is largely because this happens to be the cheapest form in which potash can usually be obtained. It is the effect of the potash, not of the chlorine, that is desired. An excess of compounds of chlorine in soils renders them barren.

(*d*) *Specific Functions in Plant Growth.*— The function of chlorine in connection with the development of plants is not satisfactorily settled. There are some reasons for believing that some of the compounds of chlorine, especially the potassium chloride (muriate of potash), are instrumental in transferring starch from the leaves, where it is formed, to the flower and fruit. There are also some suggestive experiments which favor the belief that chlorides favor the formation of cellulose (woody fiber) from sugar.

SODIUM.

(*a*) *Source.*— Sodium occurs in nature mostly in combination with the element chlorine in the form of *sodium chloride* or *common salt.* It is found everywhere in the soil, but usually in small quantities. Sodium and nitric acid form *sodium nitrate* or *nitrate of soda,* commonly known as Chili saltpeter.

(*b*) *Relation to Fertilizers.*— Sodium in the form of sodium chloride (common salt) is found in small quantities in all soils. While it appears as a regular, though small, constituent of plants, it is a disputed question whether it is a necessary constituent of plant food, but the weight of evidence appears to show that it is not necessary and that the requirements of plants do not call for the addition of sodium compounds to fertilizers. In the case of nitrate of soda, it is not the sodium, but the nitrogen in the form of nitrate, which gives the compound its value as plant food. It merely happens that the nitrate can be furnished most cheaply in this form. The application of sodium chloride as an indirect fertilizer has been found, under some conditions, to be attended with beneficial results. Sodium cannot take the place of potassium in plant nutrition.

SILICON.

(*a*) *Source.*— Silicon, next to oxygen, is the most abundant element in soils. It does not occur uncombined with other elements. Silicon combined with oxygen forms a compound commonly called *silica.* Quartz and sand are nearly pure silica.

Silicon combined with oxygen and several of the metallic elements, such as sodium, potassium, calcium, etc., forms compounds which are called *silicates.* The feldspars are silicates; clay is a silicate. Ordinary glass consists of a mixture of silicates.

(*b*) *Relation to Fertilizers.*— Silicon, in the form of silica and silicates, is abundant in all soils, and does need special attention in connection with fertilizers.

(*c*) *Specific Functions in Plant Growth.*— It is an unsettled question as to what silicon does in plant growth. Some have thought that its functions might be to give stiffness to slender stems in the case of such plants as grasses, sedges, etc., but there are some serious objections which interfere with the complete acceptance of such a proposition. Others claim, on good grounds, that silicon really performs no function in plant life, its common presence being an accident and not a necessity.

MANGANESE.

Manganese is a common constituent of soils, though present in small quantities. The weight of evidence at hand indicates that it is an accidental but common constituent of plants, performing no function in plant growth and being in no wise necessary for plant nutrition.

THE RELATIONS OF THE DIFFERENT ELEMENTS OF PLANT FOOD TO SOILS.

General Composition and Origin of Soils.— Of the 14 elements necessary to perfect plant growth, 10 come exclusively from the soil, as previously indicated. These have already been described, and we do not need to give further attention to them in this place. The soil-derived elements, though forming on an average only about five per cent. of the whole vegetable kingdom, are of the utmost interest and importance to the farmer; for, while the atmosphere is in itself entirely beyond his control, he can, through the medium of the soil, influence the amount of air-derived constituents taken up by plants.

Soils consist of decomposed rocks mixed in varying proportions with organic matter called humus, formed by the decay of animal and vegetable substances. The principal part of the soil was once solid rock, and the first step toward the formation of soil was the powdering of the rock. The conversion of rocks into soil has been accomplished by means of various agencies, such as heat and frost, moving water and ice, chemical action of air and water, and the influence of animal and vegetable life. The value of a soil for agricultural purposes depends largely upon the original material from which it was made, and upon the state of fineness to which it has been reduced.

Soil-Particles.— The fineness of division required in a good agricultural soil is not easily realized. According to estimates reliably made, a single ounce of good soil contains many *thousand-millions* separate particles. If the surface of all the particles in one cubic foot of soil could be spread out in one continuous plane, they would cover an area of two or three acres; and it is to be kept in mind that this great spread of surface is accessible to the root systems of plants in each cubic foot of such soil.

One classification of soils is based upon the size of soil-particles. The particles of a soil may be separated into two general classes. The first is called "skeleton" and consists of particles coarser than one-fiftieth of an inch in diameter. The second class is called "fine earth" and consists of all except the "skeleton." In agricultural soils "skeleton" varies from five to twenty per cent.

The "fine earth" is divided into six grades of soil-particles, called (*a*) medium sand, (*b*) fine sand, (*c*) very fine sand, (*d*) silt, (*e*) fine silt, (*f*) clay.

Sand.— The term sand, used in connection with soil-particles, includes those particles whose size varies from one-fiftieth to one-five-hundredth of an inch in diameter. These are subdivided into three grades of sand. Soils characterized as sandy contain from five to fifteen per cent. of silt and clay, as pure sand would have no agricultural value. When mixed with clay, sand serves to diminish the compactness of the clay, making it more porous and permeable to air and water. Too large a proportion of sand renders soils too porous and open, so that they admit water, warmth, and air too freely and there results excessively rapid evaporation of soil moisture together with marked heating of the soil and a consequent premature ripening and burning of the crops.

Silt.— Soil-particles included under the term silt vary in size from one-five-hundredth to one-five-thousandth of an inch. The characteristics are intermediate between sand and clay. A silt soil is more permeable to water than clay but less so than a sandy soil.

Clay.— The word clay used in connection with soil-particles has reference only to the size of the particles without regard to chemical composition. It includes all soil-particles whose size is less than one-five-thousandth of an inch in diameter. Arable soils contain from three to fifty per cent. of clay. Used in its chemical sense, clay is the common name of a compound called aluminum silicate. Clay soils must be handled with great care. When worked in too wet condition, they are puddled and this condition prevents the proper drainage of surface water. Many clay soils are too compact, retaining water and not allowing plant roots to penetrate easily.

Humus.— The word humus means, in general, the organic matter in the soil formed by the decay of animal or vegetable materials. In this sense humus is a very variable substance, its composition depending upon the materials from which it is formed and upon the conditions of decomposition. For example, humus formed from sawdust or leaves will differ very greatly from that produced by clover or cottonseed meal. In appearance humus is brown or black. Leaf-mold, swamp-muck and peat are varieties of humus, differing in appearance according to the conditions of their origin and formation.

It is known that animal or vegetable matter decaying in the soil forms compounds of an acid character and these organic acids unite with lime, potassium and other constituents of the soil. Moreover, it is known that materials rich in nitrogen, like meat scraps and cottonseed meal, produce humus that not only is rich in nitrogen but also has greater power to unite with the potash and phosphoric acid of the soil, thus rendering them more available as plant food.

Humus is extremely valuable for the following reasons:

1. Humus absorbs water much more extensively than any other ingredient of the soil, and thus promotes the water-holding and water-conserving power of the soil.

2. Humus aids in the decomposition of the mineral matters of the soil, changing unavailable into available plant food. Its action in rendering available the potash and phosphoric acid of the soil is of marked value.

3. Humus fixes ammonia in the soil, so as to prevent it from being carried away by rains. The ammonia thus fixed is held until it gradually undergoes conversion into nitrate nitrogen, in which condition it is ready for immediate use as plant food.

4. Humus improves the mechanical condition of heavy soils by making them lighter, more porous and less adhesive. It also is helpful on sandy soils, serving to bind together the loose particles of soil, enabling it to retain moisture and preventing excessive leaching of plant food.

Need of Humus in Soils.— In soils under constant cropping, there is usually a gradual loss of humus, unless special means are employed to add humus-making materials to the soil. Peat and muck soils are apt to contain an excess of humus. Sandy soils are most apt to be deficient in humus. Clay soils lose their humus less rapidly than sandy soils under like conditions.

Supplying Humus to Soils.— Humus-forming materials may be furnished the soil in the following ways: By crop roots remaining in the soil, by plowing under green crops or stubble, by addition to soil of animal and vegetable materials, such as farm manures, straw, refuse, cottonseed meal, dried blood, etc. The value of humus as a direct source of plant food and as a means of making available the insoluble potash and phosphoric acid of the soil varies according to the kind of material from which it comes. Humus from materials rich in nitrogen is more valuable than when containing less nitrogen. In supplying humus to soils, it should be remembered that the presence of lime in the soil is one of the conditions required for the production of humus of value.

Amount of Plant Food in Soil.— The proportion of plant food even in a fertile soil is comparatively small. One thousand pounds of a good soil may contain:

Phosphoric acid, 1½ pounds.
Nitrogen, 1½ pounds.
Potash, 2 pounds.

Some soils contain larger quantities than these. But when we consider the total amount of plant food in one acre of soil, the amounts appear large.

While the weight of soil in an acre of different kinds of land varies, we may take the average weight of dry soil in one acre to the depth of nine inches as approximating about 3,000,000 to 3,500,000 pounds. One acre of soil containing the proportions of plant food given above would, therefore, contain the following aggregate amounts:

Nitrogen, 4,500 pounds.
Phosphoric acid, 4,500 pounds.
Potash, 6,000 pounds.

A large portion of the plant food in the soil is not available. The character of the soil affects very considerably the available condition of the plant food. For example, a sandy soil is rendered fertile by a smaller amount of plant food than is a clay soil, owing, in part to the different condition in which the mineral food exists in the sandy soil. The insoluble condition of plant food in the soil prevents its rapid loss by leaching.

Loss of Fertilizing Constituents from the Soil.— Without going into a detailed explanation in regard to the causes, we will consider briefly the extent to which the three chief forms of plant food are liable to be lost from soils. In general, it may be said that when plant food materials come into contact with a soil, some kind of chemical combination is apt to take place between the constituents of the soil and the fertilizer. On this account, plant food when applied in soluble forms may combine with the soil to form compounds which are less soluble, but still sufficiently soluble to be utilized as food by plants.

(*a*) *Nitrogen Compounds.*— Since ammonia compounds and nitrates dissolve easily in water, is there not danger of their being carried away in drainage water from the upper soil out of reach of the plants? Experiments have been made to settle the question, and results indicate that *ammonia* compounds are largely retained until they are changed into nitrates. *Nitrates are apt to be washed out* in drainage water *and lost in the case of bare fallow land,* the loss amounting to nearly 40 pounds of nitrogen an acre in average seasons. The quantity of nitrogen lost in this way is very much greater than is used by many crops, and is, moreover, in the most available form for plant food. However, when soil is covered with vegetation there is little or no loss, for the reason that roots of growing plants absorb nitrate nitrogen very rapidly.

Some nitrogen may be lost also from organic matter undergoing decay in the soil, escaping into the air as free nitrogen. This has been shown to be very large in case of soils rich in vegetable matter when improperly managed.

(*b*) *Phosphoric Acid in Phosphates.*— The ordinary form of calcium phosphate being insoluble in water, is not, to any appreciable extent, removed from the soil by the drainage water. The soluble form of calcium phosphate would probably be lost to some extent in drainage water, were it not for the fact that it is quickly changed in the soil to the "reverted" or less soluble form and, in this "reverted" condition, the phosphate is not apt to be carried away in drainage water. In some soils, heavy clay soils, for example, soluble phosphates not used the first season by plants may enter into such insoluble combination with the soil as to become unavailable. On such soils it is, therefore, better to apply phosphates each year in quantities suitable for a single crop, rather than attempt to make one heavy application to cover a period of years.

(*c*) *Potash in Potassium Compounds* is not apt to be lost to any extent in drainage waters, since most soils have the power of changing soluble forms of potash into forms less soluble, which are gradually redissolved and given up for the use of plants.

In addition to the preceding statements, it may be said, in general, that loss of plant food is greatest in sandy soils; the coarser the sand, the greater the loss, other conditions being the same. Clay and humus have very marked power in retaining plant food.

Relations of Plants and Soils.— We have seen that a very small part of the soil furnishes the most important constituents of plant food. The soil also performs other functions than furnishing plant food. We can summarize as follows the general offices which the soil fulfills in its relation to plants:

1. The soil acts as a mechanical support for plants; the roots of the plants penetrate the soil downwards and sideways, and brace the plant firmly to its upright position.

2. The soil furnishes directly all the soil-derived elements used by the plant, and is thus immediately connected with the nutrition of plants. In addition, the soil serves as a medium for conveying to the plant a considerable portion of the air-derived elements.

3. The soil contributes to the development of plants by modifying and storing the heat of the sun, by regulating supplies of food, and, in various ways, by securing those conditions which must be present and unite to produce the fully developed plant.

4. The soil acts like a sponge to hold water for the use of plants.

Analysis of Soils.— The value of chemical analysis for ascertaining the plant-food needs of a soil is liable to be overestimated. Soil analysis has not yet reached such a stage of perfection that its results can always be interpreted correctly. It gives definite results when it shows the complete absence of one or more necessary plant-food constituents. Its chief weakness lies in the present inability to estimate accurately the amount of *available* plant food in a soil. It is only under unusual conditions that a farmer will be justified in having soil analyzed in order to learn its plant food requirements. There are other and more certain means to use for gaining this knowledge, which the farmer can apply to best advantage, as will be indicated later.

6. THE RELATIONS OF MICRO-ORGANISMS TO SOIL AND TO PLANT FOOD.

Nitrification and its Importance.— The absolute necessity of nitrogen as food for plants has been mentioned and it has also been stated that plants require this nitrogen to be supplied to them in the form of nitric acid or nitrate compounds. A plant cannot feed directly upon the nitrogen of the air, or upon the nitrogen contained in ammonia or vegetable or animal matter. All these forms of nitrogen must first be changed into nitrate nitrogen, and the work of bringing about this change is accomplished by fermentation processes caused by several different micro-organisms or germs, constituting a chain of workers in a simple division of labor. The organic nitrogen of dried blood, bone, cottonseed meal, stable manure, etc., is changed into *ammonia* by one set of workers; the ammonia is taken by another set and carried along to another stage called *nitrous acid,* and this in turn is changed into *nitric* nitrogen by a third set of works. The general process by which nitrogen in other forms is changed into nitrate nitrogen is commonly spoken of as *nitrification.* The importance of the work done by these different micro-organisms working together can be appreciated, when we realize that without their work no plants could be grown and all forms of vegetable and animal life would perish.

These micro-organisms are the smallest imaginable kinds of plants and we cannot see them singly by the unaided eye. They are commonly called germs. Another name for many of them is *bacteria.*

Number of Micro-Organisms in Soil.— The number of different kinds of micro-organisms in the upper portion of ordinary cultivated soils varies roughly from one to fifty millions to the ounce. The number diminishes rapidly below a depth of 30 inches. At six feet below they nearly disappear. The number is greater in cultivated than in uncultivated soils, in well-fertilized soils than in unfertilized soils, in soils rich in humus than in light sandy soils. The number is greater in summer than in winter. The addition of organic matter like stable manure greatly increases the number of germs. As a rule, an increase in the amount of available plant food in the soil follows an increase in the number of micro-organisms or bacteria. Such increase can be secured by thorough cultivation, liberal manuring, and the use of leguminous plants as green manures.

Conditions Required for Nitrification.— The activity of the micro-organisms which prepare unavailable forms of nitrogen for the use of plants by converting them into nitrate nitrogen is hastened by certain favorable conditions and retarded by unfavorable ones. The principal conditions that have to be considered in relation to the growth of these micro-organisms will now be mentioned.

(*a*) *The Presence of Moisture.*— In a dry soil nitrification does not take place. Hence, in periods of drouth this important process stops in the upper portions of the soil. In a wet soil, on the other hand, where water is stagnant, this process does not take place actively.

(*b*) *Food Requirements of Nitrifying Organisms.*— The organic matter of the soil forms the main supply of organic food for these organisms. It is possible to have so much organic matter present that the organisms will stop growing, as in a manure pile. It is also necessary that certain forms of mineral matter be present, chief among which is a supply of phosphoric acid compounds.

(*c*) *Oxygen Required.*— Nitrifying organisms cannot flourish without a supply of air. Water-saturated soils prevent the process by shutting off the air supply. The stirring and pulverizing of the soil by cultivation greatly promotes the change into nitrate nitrogen, because it brings the oxygen of the air into closer contact with the nitrifying ferments.

(*d*) *Temperature of Soil.*— The nitrifying organisms work most rapidly between the temperatures of 54 degrees and 99 degrees Fahrenheit. The process may take place as low as 37 degrees Fahrenheit and as high as 120 degrees Fahrenheit. In this latitude nitrification stops during the winter, while in warm climates it continues during the whole year.

(*e*) *Some Material Like Lime Necessary.*— The presence of some mineral compound in the soil that will prevent acid condition of soil is necessary, since the action of these micro-organisms is checked by acids. The lime compounds are the most available ones. Hence, it is important to lime soils occasionally, in order that the preparation of nitrate nitrogen can take place.

Conversion of Atmospheric Nitrogen into Plant Food by Micro-organisms.— Another most important work done by certain micro-organisms is the production of nitrogenous plant food from the nitrogen of the air. Certain plants, known as leguminous, such as clover, peas, beans, etc., have been proved to utilize atmospheric nitrogen as a source of food supply. They are able to accomplish this through the action of certain germs. If the roots of a healthy clover plant are examined, there will be found on them little round bunches or tubercles, varying from the size of a shot to that of a pea. These have been found to be colonies containing enormous numbers of germs having the power to assimilate atmospheric nitrogen. They are accompanied by other germs which change the nitrogen, thus taken from the air, into nitrate nitrogen, which the plant uses as food.

Loss of Nitrogen through Micro-Organisms.— The soil contains certain kinds of germs which have a power opposite to that of nitrifying germs; that is, they change nitrates back through different forms into some form that is likely to escape into the air and be lost as plant food. This process is known as denitrification, which is simply the destruction of nitrates as plant food. These germs are abundant also in straw and in stable manure. It is important to know the conditions under which this destructive process takes place and thus learn to avoid such losses.

(*a*) *Absence of Air* is favorable to the destruction of nitrates. Too much water in the soil has the effect of shutting off the supply of air and thus the denitrifying organisms are enabled to do their injurious work. Good drainage and thorough tillage will overcome this condition.

(*b*) *An Excessive Amount of Humus* in the soil favors the destruction of nitrate compounds. This is a condition not often met in common farm practice.

(*c*) *Loss of Nitrogen from Stable Manure.*— Those organisms that feed upon nitrate are very abundant in stable manure and straw. These losses can be prevented by using preservatives in the manure as described later, and also by using bedding material free from decomposable organic matter.

PART II.

CLASSIFICATION AND DESCRIPTION OF MATERIALS USED AS FERTILIZERS.

1. CLASSIFICATION AND DEFINITION OF TERMS USED IN CONNECTION WITH FERTILIZERS.

A Fertilizer may be defined as any substance which, by its addition to the soil, will produce a better growth of plants under favorable conditions.

The materials which come under the head of fertilizers are numerous in kind, and different both in form and the manner in which they act.

The following tabulated classification, while not strictly accurate in every respect, will serve to give a good general idea of the number and relations of the terms used in speaking of fertilizers:

FERTILIZERS, ...
- **I. Direct or Nutritive.**
  - **1. Natural.**
    - Stable manure.
    - Refuse vegetable matter.
    - Green crops for plowing under.
    - Cotton seed, etc.
    - Muck, marls, etc.
    - Animal refuse.
  - **2. Artificial.**
    - Commercial, Chemical, or Prepared.
      - **a. Complete or general.**
      - **b. Incomplete or special.**
- **II. Indirect or Stimulant.**
  - **Lime.**
  - **Gypsum.**
  - **Salt, etc.**

These terms are, in general, loosely and indiscriminately used, as their meaning is often misunderstood; and so an attempt will be made here to define them in accordance with the best usage of the terms.

A Direct Fertilizer is one containing elements of plant food that are available at once or easily become so, that is, which can be taken up and used either immediately or within a short time by plants.

The term *Available* is applied to plant food which is *soluble,* that is, in such a condition that the roots of the plant can take it up readily in solution.

Plant food is *Unavailable,* when it is in such a form, that the roots of the plant fail to take up any part of it. A large proportion of plant food present in the soil is unavailable because insoluble, but by the action of air, water, carbonic acid, etc., it is gradually changed to soluble or available forms, which the plant can take up and use. As will be noticed later, phosphoric acid in the form of *insoluble* calcium phosphate or phosphate of lime is unavailable as plant food, but when converted into a superphosphate or *soluble* calcium phosphate, it becomes available. Organic nitrogen is unavailable until it is changed into nitrate nitrogen. Unavailable plant food is *potential* food or food in reserve.

An Indirect Fertilizer is one which does not furnish to the soil any needed plant food and which may not be plant food at all, but which is characterized by the way in which it acts on the matter already in the soil, changing more or less of it from unavailable plant food to an available form, or producing some other beneficial effect in the soil. For example, lime, gypsum, salt, etc., are indirect fertilizers, as they are generally used by farmers. Later some attention will be given to the action of some of the most familiar indirect fertilizers. They are commonly used by farmers, not because the elements they furnish are lacking in the soil, but because they can act upon unavailable plant food and render it available, or because they may have some beneficial influence upon the mechanical condition of the soil.

Natural Fertilizers include the solid and liquid excrement of animals, all kinds of vegetable refuse, green crops for plowing under, cotton seed, mucks, marls, refuse animal matter, etc.

Artificial Fertilizers are also known by such names as *commercial fertilizers, chemical fertilizers, etc.,* and are artificial preparations or mixtures of fertilizing materials sold under trade names. The fertilizing materials used in making these mixtures include the substances found in natural deposits and by-products of numerous industries, which are obtainable by farmers only through the channels of trade. Some substances which might be classed as natural fertilizers, such as cotton seed meal and tobacco stems, are also included among the materials of artificial fertilizers.

Complete Fertilizers, known also as *general fertilizers,* are those which contain nitrogen, phosphoric acid and potash.

Incomplete Fertilizers, also called *special fertilizers,* are those which contain only one or two of the three constituents, nitrogen, phosphoric acid and potash.

There is a common practice among farmers and dealers of calling all commercial fertilizers "phosphates," regardless of whether they contain any phosphates at all or not. The practice is clearly objectionable, because a phosphate is not the only fertilizing constitutent presented in commercial fertilizers — in some cases it may be entirely absent. The term "superphosphates" applies truthfully to many commercial fertilizers, but even these cannot be correctly spoken of as simply "phosphates." This common usage of the term "phosphate" for any form of fertilizer emphasizes the fact that there has been a tendency to overestimate the value and importance of this constitutent, resulting in large applications of it without regard to the needs of soil or crop.

2. FORMS OF PLANT FOOD ESSENTIAL TO FERTILIZERS.

In the absence of iron in the soil, plants turn yellow and cease to grow; other elements, as magnesium, sulphur, etc., are essential to the complete development of a plant. But these elements are used by plants in very small quantities, and, moreover, they occur abundantly everywhere in soils, as already indicated. Therefore, it is rarely necessary to supply these elements artificially to soils, and we do not need to consider them in connection with fertilizers. The elements of plant food which experience most often shows to be lacking in soils are these four:

Nitrogen, Potassium (contained in potash compounds), *Phosphorus* (contained in phosphoric acid compounds or phosphates), and in special cases, *Calcium* (contained in lime compounds).

3. STIMULANT OR INDIRECT FERTILIZERS.

A Stimulant or Indirect Fertilizer is one which does not in itself furnish directly to the soil any needed plant food, but whose chief value depends upon the power it possesses of changing unavailable into available forms of plant food. The stimulant or indirect fertilizers which have been most commonly employed are lime, gypsum and common salt.

Gypsum or Land Plaster, known also as calcium sulphate or sulphate of lime, has been much used in fertilizing crops. Its value is due to its action as an *indirect* fertilizer. There has been much difference of opinion as to the manner in which gypsum acts. Probably it acts in at least three different ways, as follows:

1. It has the power to form compounds with ammonia, in which the ammonia is no longer in danger of loss by evaporation. This power of fixing ammonia is probably of little value when plaster is applied to the surface of the soil, but it may be of much value when scattered over a heap of fermenting manure, and

moistened with water, when it will retain the ammonia which would otherwise escape. For the same reason, plaster is useful to distribute about stables, so that it may mix with the manure.

2. It has been shown that gypsum in some manner aids the process of nitrification, by which ammonia and the nitrogen of organic matter are converted into nitrate nitrogen.

3. Gypsum acts upon the insoluble forms of potash and some other elements of plant food, converting them into soluble and available forms which plants can readily take up and use. This is probably the most important effect of plaster as an indirect fertilizer.

In whatever way gypsum may act, it is well established that it is of value when applied on certain soils to certain crops, such as clover, peas, lucern and similar plants. Nearly all fertilizers containing soluble phosphoric acid contain gypsum, as will be explained later.

The more common sources of supply of land-plaster are Nova Scotia and central New York, the latter being less pure.

Quicklime.—Quicklime or burnt lime or calcium oxide, commonly called lime, is known to be valuable as an indirect fertilizer. It produces changes in both the physical and the chemical character of soils. It changes the mechanical condition of soils by loosening heavy clay soils and also by holding together and giving body to light sandy soils. Freshly burned lime acts chemically upon soils by decomposing vegetable and mineral matter already present in the soil and changing them into forms which are available as food for the plant. Thus, lime acts upon insoluble mineral substances containing potash, soda, etc., and converts them into soluble forms which plants can use. Lime aids in the decomposition of animal and vegetable matter, such as vegetable mold, stable manure, etc., and tends to convert them into available plant food. Lime also neutralizes the acidity or "sourness" of soils. We shall later consider the conditions under which lime can be used to advantage and also the methods of its use.

Gas-Lime.— Quicklime is used in gas works for the purpose of removing impurities from the gas. In the operation the lime becomes slaked and takes up various materials that are injurious to plant life; however, these impurities, on exposure to air, are changed into harmless forms. In using gas-lime on soils, it should either be exposed to the air some time previous to applying to soil or should be applied some weeks or even months before putting the crop in the soil. Gas-lime may contain a small amount of nitrogen.

Common Salt has an indirect fertilizing value which is due to the fact that it has the power of changing unavailable forms of plant food into available forms, and increasing the power of soils to absorb water. Salt probably furnishes no needed form of plant food. All the salt that can probably be utilized to advantage is contained as impurities in some of the potash salts, such as kainit.

Danger in using Stimulant Fertilizers.— It should be kept in mind that these stimulant fertilizers are not used for the plant food contained in them; hence, as used, they do not furnish needed plant food. The chief value of their use lies in the fact that they can change unavailable into available forms of plant food. It can readily be seen that, when stimulant fertilizers are used exclusively for a term of years, the soil each year loses nitrogen, potassium and phosphorus compounds, which are not replaced. The inevitable result of such treatment is the exhaustion of these important food constituents from the soil. This affords an explanation of the question often raised now as to why the application of land-plaster does not give such results in crop yields at present as in former days. When land-plaster was the only fertilizing material added to soils for years in succession, it was possible to produce increased crops, so long as there were in the soil enough compounds of nitrogen, potassium and phosphorus to be rendered available by the action of the land-plaster. When, therefore, these forms of plant food were largely removed, there was nothing for the land-plaster to act upon, in order to increase the supply of available food material. The land plaster furnished no needed food, but simply helped the crops to use up more rapidly the store of plant food present in the soil.

4. NUTRITIVE OR DIRECT FERTILIZING MATERIALS.

Nutritive or Direct Fertilizers contain forms of plant food, which contribute directly to the growth and substance of plants. Such materials may contain either nitrogen or potash or phosphoric acid compounds, or any two, or all three of these forms of nutriment. We shall consider these various materials under the following heads:

(*a*) Commercial fertilizing materials containing nitrogen compounds.

(*b*) Commercial fertilizing materials containing phosphoric acid compounds.

(*c*) Commercial fertilizing materials containing potash compounds.

(*d*) Farm-produced fertilizing materials.

This division is not sharply defined, since one material may contain more than one form of nutriment; however, in most cases, each kind of material contains some one of the three forms of plant food in much larger proportions than any other form. Owing to the value of farm-produced manures and to the importance of calling special attention to their value, we treat this subject under a separate head in connection with the forms of materials used in commercial fertilizers.

(*a*) *Fertilizing Materials Containing Nitrogen Compounds.*

The various materials which are used to furnish nitrogen in commercial fertilizers are derived from three general sources, which we can indicate as follows:

(1) Mineral nitrogen compounds.
(2) Vegetable nitrogen compounds.
(3) Animal nitrogen compounds.

(1) *Commercial Fertilizing Materials Containing Mineral Nitrogen Compounds.*

The forms of mineral compounds containing nitrogen, most commonly found in the market, are *nitrate of soda* and *sulphate of ammonia.*

Nitrate of Soda, known also as "Chili saltpeter," is found in large deposits which have been formed in the rainless regions of Chili and Peru. As it is mined, the nitrate of soda is quite impure, the chief impurity being common salt. Before being sent to market, it is purified, and the form in which farmers purchase it generally contains from 95 to 96 per cent. of real nitrate of soda. Stated in another way, 100 pounds of good commercial nitrate of soda contain from 15½ to 16 pounds of nitrogen.

Sulphate of Ammonia is formed from waste materials produced in the manufacture of illuminating gas. This is the most highly concentrated form of nitrogen commonly found in the market. One hundred pounds of sulphate of ammonia contain about 25 pounds of ammonia, which is equivalent to about 20½ pounds of nitrogen.

(2) *Commercial Fertilizing Materials Containing Vegetable Nitrogen Compounds.*

While nitrogen may be supplied by many forms of vegetable matter, only a few substances of this kind are used in commercial fertilizers, chief of which are *cotton seed meal, castor bean pomace, linseed meal, and tobacco stems.*

Cotton seed Meal is the product formed by removing the oil from the seed by pressure, after which the material is dried and ground. It has been used at the South mainly for fertilizing purposes. One ton of cotton seed meal contains about 140 pounds of nitrogen, 60 pounds of phosphoric acid and 40 pounds of potash. It is valued highly as a food for cattle, and, when thus fed, practically all of the fertilizing value is recovered in the manure. When it can be purchased at a moderate price, it makes a valuable fertilizer to be applied directly to the soil. The hulls of the cotton seed also possess considerable fertilizing value.

Castor Bean Pomace is a by-product of castor-oil factories; it is made by about the same process as that used in producing cotton seed meal. As a rule, it has less fertilizing value than cotton seed meal, one ton containing about 110 pounds of nitrogen, 40 pounds of phosphoric acid and 20 pounds of potash.

Linseed Meal is the product left after removing oil from flax seed. One ton of linseed meal contains about 110 pounds of nitrogen, 37 pounds of phosphoric acid, and 28 pounds of potash. Its extensive use as a cattle food makes it too high priced for common use as a source of nitrogen for fertilizers.

(3) *Commercial Fertilizing Materials Containing Animal Nitrogen Compounds.*

Probably the larger proportion of the nitrogen occurring in commercial fertilizers is at present furnished by animal matter in one form or another. This material comes mainly from slaughter-houses, rendering works and fish-oil factories. The following list contains most of the substances of animal origin commonly used: *Azotin or ammonite, dried blood, dried fish, fish scraps, garbage tankage, ground fish, hair, hoof meal, horn dust, leather meal, nitrogenous guanos, tankage, wool-waste, etc.*

Azotin or Ammonite consists of dried and ground meat, tendons, membranes, etc., from which fat has been extracted. It usually contains over 10 per cent. of nitrogen along with 3 or 4 per cent. of phosphoric acid.

Dried Blood consists of blood obtained from slaughtered animals; it is prepared for market by evaporating, drying and grinding. The color varies with the degree of heat employed in drying, ranging from red to black. Red blood is of higher grade than black blood. The red dried blood contains 13 to 15 per cent. of nitrogen with very little phosphoric acid. Black dried blood contains from 6 to 12 per cent. of nitrogen and usually some phosphoric acid. It is this lower grade of dried blood that is most commonly employed in the manufacture of fertilizers.

Dried Fish, Fish Scraps, and Ground Fish consist of refuse from fish-oil works, and fish-canning factories. The material obtained from fish-oil works is the residue left after the extraction of oil; it is prepared for market by drying and grinding. It is quite uniform in composition, containing 7 to 8 per cent. of nitrogen and as much or more phosphoric acid. The product obtained from canning works consists of skin, bones, etc., of fish and is very variable in composition.

Tankage is slaughter-house refuse made up of miscellaneous refuse matter such as bone, tendons, hair, hides, horns, hoofs, etc. Two kinds of tankage are known in the market. One kind is known as concentrated tankage and is made by evaporating some of the fluids rich in nitrogen. This form of tankage contains 10 to 12 per cent. of nitrogen with only a little phosphoric acid. The second kind is known as crushed tankage and consists of varying quantities of different parts of animal carcasses. As a rule, the fat and gelatin are first removed by straining or boiling and the residue is dried and ground. Sometimes a little slaked lime is added to prevent loss of nitrogen by rapid fermentation. Crushed tankage varies greatly in composition, the nitrogen ranging from 4 to 9 per cent. and the phosphoric acid from 3 to 12 per cent.

Garbage Tankage is material obtained by drying city garbage. Sometimes it is partially charred. Its composition varies greatly, containing nitrogen, phosphoric acid, and potash, but in small proportions. It is usually richer in nitrogen than in any other plant food. It is a low-grade fertilizing material. Both its composition and value as plant food are variable and uncertain.

Hair is obtained from slaughter-houses; it is often mixed with dried blood and other forms of animal matter. It contains about 15 per cent. of nitrogen. Wool-waste is much like hair in composition.

Hoof Meal and Horn Dust are by-products containing 10 to 15 per cent. of nitrogen and about two per cent. of phosphoric acid.

They are sometimes treated with superheated steam or with sulphuric acid, the treatment rendering the nitrogen compounds more readily available.

Leather Scraps and Leather Meal are waste products of various factories. When treated with superheated steam and dried or roasted, they can be very finely ground. Roasted, finely ground leather is used to adulterate dried blood, having much the same appearance.

Nitrogenous Guanos are formed in warm dry regions. Peruvian guano is rich in nitrogen, containing seven per cent. or more, mainly in the form of sulphate of ammonia. Guanos of this kind have largely disappeared from the market.

The following table gives the approximate quantities of nitrogen contained in various fertilizing materials:

Materials Containing Nitrogen.	**Average per cent. of nitrogen.**	**Pounds of nitrogen in 2000 pounds of material.**
(1) *Mineral materials.*		
Nitrate of potash	13 to 14	260 to 280
Nitrate of soda	15½ to 16	310 to 320
Sulphate of ammonia	19 to 20½	380 to 410
(2) *Vegetable materials.*		
Cotton seed meal	6 to 7	120 to 140
Castor bean pomace	5 to 6	100 to 120
Linseed meal	5 to 6	100 to 120
Tobacco stems	2 to 2½	40 to 50
(3) *Animal materials.*		
Azotin, ammonite	10 to 12	200 to 240
Dried blood, red	13 to 15	260 to 300
Dried blood, black	6 to 12	120 to 240
Dried fish	7 to 8	140 to 160
Hair	14 to 16	280 to 320
Hoof meal, horn dust	10 to 15	200 to 300
Leather scraps, leather meal	7 to 8	140 to 160
Meat scraps	10 to 12	200 to 240
Nitrogenous guanos	7 to 8	140 to 160
Oleomargarine refuse	10 to 12	200 to 240
Tankage, concentrated	10 to 12	200 to 240
Tankage, crushed	4 to 9	80 to 180
Tankage, garbage	1 to 2	20 to 40
Wool waste	5 to 6	100 to 120

(*b*) *Fertilizing Materials Containing Phosphoric Acid Compounds.*

Phosphoric acid is generally found in combination with lime (calcium), forming four different compounds, viz.:

(1) Insoluble phosphate of lime, or tri-calcium phosphate.
(2) Soluble phosphate of lime, or mono-calcium phosphate.

(3) Reverted phosphate of lime, or di-calcium phosphate.
(4) Tetra-calcium phosphate.

(1) *Insoluble Phosphate of Lime.*

This is known under several other names, as "insoluble calcium phosphate," "normal calcium phosphate," "tri-calcium phosphate," "bone phosphate of lime," etc.

This form of calcium phosphate is called *insoluble* because it does not dissolve in water.

It is found in nature in large quantities in several minerals, which will be noticed later. It also constitutes about 85 per cent. of the ash or inorganic matter of bones. It is also contained in the excrement of animals, as in guano, etc.

Insoluble phosphate of lime is found everywhere in the soil. However, in this form, calcium phosphate has the least value for the farmer, because it is not easily dissolved and cannot, therefore, be taken up and used by plants, except very slowly. To make the insoluble phosphate available for plants so that they can take it up, the insoluble phosphate must be converted into some form which is soluble; that is, which dissolves in water. This can be done by treating it with sulphuric acid (oil of vitriol).

(2) *Soluble Phosphate of Lime.*

This is known under several other names, as "acid phosphate of lime," "acid calcium phosphate," "acid phosphate," "superphosphate of lime," "superphosphate," "mono-calcium phosphate," etc. It is not found naturally occurring.

As indicated above, the soluble calcium phosphate is made by treating insoluble calcium phosphate with sulphuric acid. By this treatment, a portion of the calcium is removed from the phosphate and unites with the sulphuric acid, forming sulphate of lime or gypsum in addition to the soluble phosphate. This mixture of the soluble phosphate and gypsum is known as "superphosphate of lime." The phosphate in this form, being easily soluble in water, can be readily taken up by plants, and is, therefore, of great value as a fertilizer. The sulphate of lime is also known to have value as an indirect fertilizer. In plain superphosphate of lime there are generally formed about 116 pounds of water-free sulphate of lime (equivalent to 147 pounds of gypsum) for each 100 pounds of soluble phosphate of lime. The value of superphosphates depends upon the amount of soluble phosphate contained in them. Soluble phosphate of lime, whatever its source, whether bone or rock, is one and the same chemical compound, and as such has the same value as plant food.

(3) *Reverted Phosphate of Lime.*

Reverted phosphate of lime is known also as "reverted calcium phosphate," "precipitated phosphate of lime," "di-calcium phosphate," "citrate-soluble phosphate," etc.

When soluble phosphate of lime is allowed to stand for some time, it will happen under certain conditions that some of the soluble phosphate is changed into a less soluble form of phosphate. This is not the same form as ordinary insoluble calcium phosphate above described; for a reverted phosphate, while insoluble in water, can be readily dissolved by weak acids or by water containing carbonic acid or salts of ammonia. Since the soil and plant roots generally contain acids sufficiently strong to dissolve reverted phosphates, phosphoric acid in this form is generally regarded as very nearly equal to soluble phosphates in value as a fertilizer. The term "reverted" was introduced to express the fact that the phosphoric acid in this form had once been soluble in water, but that it had "reverted" or "gone back" to a form insoluble in water.

The reverted form of phosphoric acid is often found in small quantities in connection with insoluble phosphates, and in larger amounts in guanos; it is also found to a considerable extent in bones and other forms of organic matter.

(4) *Tetra-calcium Phosphate.*

Tetra-calcium phosphate is a form of phosphate of lime found in phosphate slags. It contains more lime in proportion to phosphoric acid than any other form of phosphate. While it is insoluble in water, it has been found to be more available as plant food than insoluble phosphate of lime.

Summary.— Of the forms of phosphate of lime which are used as food for plants, we have:

1. The ordinary *insoluble* phosphate of lime, which can be changed by treatment with sulphuric acid into —
2. The *soluble* phosphate of lime, and this, on standing, may, under certain conditions, undergo change, forming —
3. The *reverted* phosphate of lime, which is insoluble in pure water, but soluble in the acids of the soil and plants and in water containing carbon dioxide.

The soluble and reverted forms of phosphoric acid, taken together, are called *available* phosphoric acid.

Chemical Differences of the Four Phosphates of Lime.

	Calcium — per cent.	Phosphorus — per cent	Oxygen — per cent.	Hydrogen — per cent.
Insoluble phosphate of lime Insoluble calcium phosphate Normal calcium phosphate Tri-calcium phosphate Bone phosphate of lime, etc.	38.7	20.0	41.3	0
Soluble phosphate of lime Acid phosphate of lime Superphosphate of lime Mono-calcium phosphate Acid calcium phosphate, etc.	17.1	26.5	54.7	1.7
Reverted calcium phosphate Precipitated phosphate of lime	29.4	22.80	47.0	0.8
Tetra-calcium phosphate	43.7	17.0	39.3	0

We notice the following points of difference in composition:

1. The *insoluble phosphate of calcium* contains the second largest amount of calcium, the second smallest amount of phosphorus, the second smallest amount of oxygen and no hydrogen.
2. The *soluble phosphate of calcium* contains the smallest amount of calcium and the largest amount of phosphorus, oxygen and hydrogen.
3. The *reverted calcium phosphate* contains amounts of calcium, phosphorus, oxygen and hydrogen which are intermediate between the two forms preceding.
4. The *tetra-calcium phosphate* contains the largest amount of calcium, the smallest amounts of phosphorus and oxygen and no hydrogen.

With regard to phosphorus, which is the most valuable element in these phosphates of lime, the soluble phosphate of lime contains most of this element; the tetra-calcium phosphate of lime the least, and reverted phosphate is second in regard to the amount of phosphorus contained in it.

Having called attention to the different kinds of compounds in which phosphorus is found, we are now prepared to consider more intelligently the different materials in which the phosphoric acid compounds of commerce are supplied for fertilizers. The materials which furnish the greatest proportion of phosphoric acid used in making fertilizers are the following: *Bones, bone-ash, bone-black, bone-meal, fish, phosphatic guano, rock-phosphate, superphosphates, Thomas slag, vegetable matter, etc.*

Bones.— Bones consist of two quite different kinds of material, in addition to water. The hard portion consists mostly of phosphate of lime, and constitutes from one-half to three-fifths of the weight of the bone. The remaining portion consists largely of a soft, flesh-like substance called ossein, or, more commonly, gelatin, together with more or less fat. It is distributed throughout the entire mass of bone and is rich in nitrogen. When bones are burned, the nitrogenous matter is driven off and only the mineral portion or phosphate of lime remains. The amount of nitrogen and phosphate of lime in bones varies with the kind of bone and also with the manner in which it is treated. Bones of different kinds of animals vary in composition and also different bones in the same animal. Age affects composition. The bones of young animals usually contain more nitrogen and less phosphate of lime, the reverse being true of older animals. As bones come into market for use as fertilizers, their variation of composition is due more to the manner in which they are treated than to differences of composition originally existing in the bones. We find in the market the following forms of bone as the common ones: Raw bone, bone-meal, steamed bone, and bone tankage.

Raw Bone.— By raw bone is understood bones that have been ground in their natural state without previous treatment, such as steaming, boiling, etc. Raw bone contains the fat naturally present in bones and this is objectionable, because it makes grinding more difficult and delays the decomposition of the bone in the soil, while fat itself has no value as plant food. Good raw bone should contain 4 to 5 per cent. of nitrogen and 20 to 25 per cent. of phosphoric acid, equivalent to 45 to 55 per cent. of phosphate of lime.

Bone-Meal goes under various names, such as ground bone, bone-flour, bone-dust, fine bone, etc. These terms are supposed to refer to fineness of division rather than to composition. They are more commonly used of steamed than of raw bone-meal. The fineness of the bone affects its value; the finer the meal, the more readily available is it as plant food. On account of the increased demand for bones for various purposes, and on account of their increasing value, there is considerable *tendency to adulterate bone-*

meal with such substances as lime, gypsum, coal-ashes, ground oyster-shells, ground rock-phosphate, etc.

The composition of bone-meal varies, according to its manner of preparation. Bone-meal from raw bones has the composition given above for raw bones, while bone-meal from steamed bone will contain less nitrogen and more phosphate of lime.

Steamed Bone.— Raw bones are treated under pressure by steam and by this means the ossein and fat are removed, the ossein being used chiefly for making glue and gelatin and the fat for making soap. The bones after this treatment are very brittle and, when dry, can easily be ground fine. The composition of steamed bone depends upon the thoroughness and extent of steaming or boiling. Bone from glue factories averages about 1.5 per cent. of nitrogen and 29 per cent. of phosphoric acid.

In some cases, the fat alone is extracted from bones by some solvent like petroleum or benzine, which removes none of the nitrogen. Such bone may contain as much as 6 per cent. of nitrogen with 20 per cent. of phosphoric acid.

The thorough steaming of bone appears to change the nature of the nitrogen compounds or perhaps the mechanical condition of the bone in such a way as to permit more rapid decomposition in the soil than in case of raw bone. The presence of easily decaying nitrogen compounds in bone hastens, in the process of decomposition, to render soluble more or less of the insoluble phosphate.

Bone-Tankage.— While tankage is rich in nitrogen, some grades contain an abundance of phosphoric acid. Several distinct grades of tankage are now recognized, varying in phosphoric acid content from about 6 to 20 per cent. The higher grades are nearly like bone in their proportion of phosphoric acid. The higher the phosphoric acid in tankage, the lower is the nitrogen content. As previously stated, tankage is made from residues obtained from boiling refuse animal matter, heads, feet, etc. Hence the phosphoric acid of tankage may be regarded as having the same agricultural value as the phosphoric acid of steamed bone having the same degree of fineness.

Bone-Ash.— As the name implies, bone-ash is made simply by burning bones in the open air. The nitrogen is, of course, driven off and lost in burning, and the chief constituent is insoluble calcium phosphate, equivalent to 30 to 35 or more per cent. of phosphoric acid.

Bone-Black, known also as bone charcoal and animal charcoal, is extensively used in refining sugar. After it has been used several times, portions become useless for refining purposes and are then sold as fertilizer. Bone-black is made by heating bones in closed vessels, the air being excluded. By heating bones in this manner, the fat, water, and nitrogen are removed from the bones; and the bone-black remaining consists mainly of insoluble calcium phosphate and carbon or charcoal. The presence of the carbon hinders the decomposition of the phosphate, so that it is, in this form, not readily available as food for plants. Good bone-black may contain 30 or more per cent. of phosphoric acid.

Fish.— Phosphoric acid is contained in fish and fish-scrap to the extent of 7 or 8 per cent. In many cases the fish is acidulated with sulphuric acid and its phosphoric acid is thus nearly all rendered available.

Phosphatic Guanos or Rock-Guanos.— Guanos generally consist chiefly of the dung of sea-fowls, though the term is applied to other animal products. They are generally found in beds resembling earthy deposits. The guanos which are called phosphatic contain little or no nitrogen. Their phosphoric acid is generally in the form of insoluble phosphate of lime, iron and alumina. These guanos come mainly from certain islands in the Pacific ocean, and from Caribbean sea and West India islands. The amount of phosphoric acid in different guanos is very variable, ranging from below 15 to over 30 per cent.

Rock Phosphates or mineral phosphates are known under several different names, which generally designate the localities from which they come, as South Carolina Rock, Florida Rock, Tennessee Rock, West India Rock, etc. Other forms of mineral phosphates are known under the names of Apatite, Coprolite and Phosphorite, which are found in various places in America and Europe, and some of which are used in making commercial fertilizers. However, the greatest source of supply of phosphoric acid is the phosphate rock of our Southern States. The rock-phosphates are extensively used in making superphosphates. When ground to a very fine flour-like powder, rock-phosphates are called "floats." Rock-phosphates contain usually from 20 to 30 per cent. of phosphoric acid, and some as much as 35 or 40 per cent.

Superphosphates are known under several different names, such as acid phosphate, dissolved bone, dissolved rock, dissolved bone-black, etc. Superphosphates are formed by treating some form of insoluble phosphate of lime, as rock-phosphate, bone,

bone-ash, etc., with sulphuric acid. With high grade material, equal parts of sulphuric acid and rock-phosphate are used in dissolving the insoluble phosphate of lime. By this treatment there is formed a mixture of soluble phosphate of lime and gypsum (sulphate of lime) in which there are about one and one-half pounds of gypsum for each pound of soluble phosphate. Owing to their comparative cheapness and abundance, rock-phosphates are more often used in making superphosphates than bones, bone-ash or bone-black. The value of a superphosphate depends upon the amount of soluble phosphate of lime present in it together with the amount of reverted phosphate of lime. The amount of soluble phosphoric acid compounds in superphosphates varies with the kind of phosphate used in making superphosphates, and also with other conditions which we need not mention here. Good quality of dissolved bone contains 12 to 18 per cent. of soluble phosphoric acid. Dissolved bone-black contains from below 15 to 17 per cent. of soluble phosphoric acid. Superphosphate made from rock-phosphate may contain from 12 to 18 per cent. of soluble phosphoric acid.

"Double superphosphate" is a name applied to a concentrated form of soluble phosphoric acid. It is chiefly manufactured in Europe and is little used in the United States. Double superphosphate contains 35 to 45 per cent. of phosphoric acid in soluble forms.

Thomas Slag is more familiarly known as odorless phosphate. It is also known under several other names, such as basic iron slag, Thomas scoria, phosphate slag, etc. This is a comparatively new source of phosphoric acid compounds. It is a by-product formed in the manufacture of iron and steel from certain kinds of iron ore — containing phosphorous compounds. In the process a phosphate of lime is formed, which is ground to a fine powder. Odorless phosphate is insoluble in water, but is somewhat soluble in ammonium citrate solutions and its phosphoric acid is, therefore, available to some extent. The phosphoric acid is in the form known as tetra-calcium phosphate. It contains 15 to 20 per cent. of phosphoric acid, about one-third of which is citrate-soluble, and, in addition, large proportions of lime and iron oxide. The practical results coming from the use of this form of phosphoric acid compounds have been varied, often being most excellent and again very indifferent.

In the table following, we give the amounts of different forms of phosphoric acid found in different phosphate materials:

Approximate Amount of Phosphoric Acid in Fertilizing Materials.

Materials Containing Phosphoric Acid.	Available Phosphoric Acid.		Insoluble Phosphoric Acid.		Total Phosphoric Acid.	
	Per cent.	Pounds in 2,000 pounds of material.	Per cent.	Pounds in 2,000 pounds of material.	Per cent.	Pounds in 2,000 pounds of material.
Apatite			33 to 40	660 to 800	33 to 40	660 to 800
Bone-ash			30 to 35	600 to 700	30 to 35	600 to 700
Bone-black			25 to 35	500 to 700	25 to 35	500 to 700
Bone-black (dissolved)	12 to 18	240 to 360	1 to 2	20 to 40	13 to 18	260 to 360
Bone-meal	4 to 8	80 to 160	16 to 17	320 to 340	20 to 25	400 to 500
Bone-meal (from glue factory)	6 to 8	120 to 160	16 to 20	320 to 400	22 to 28	440 to 560
Bone-meal (dissolved)	12 to 18	240 to 360	2 to 8	40 to 160	14 to 20	280 to 400
Caribbean guano					18 to 20	360 to 400
Cuba guano					12 to 14	240 to 280
Double superphosphate	35 to 45	700 to 800			35 to 45	700 to 800
Florida rock					25 to 35	500 to 700
Florida soft phosphate					18 to 30	360 to 600
Keystone concentrated phosphate	35 to 40	700 to 800	7 to 8	140 to 160	45 to 48	900 to 960
Mona Island guano	7 to 8	140 to 160	13 to 15	260 to 300	20 to 22	400 to 440
Navassa phosphate					23 to 35	460 to 700
Orchilla guano					25 to 30	500 to 600
Peruvian guano	5 to 8	100 to 160	5 to 7	100 to 140	10 to 15	200 to 300
South Carolina rock (ground)					25 to 30	500 to 600
South Carolina rock (floats)					25 to 30	500 to 600
South Carolina rock (dissolved)	10 to 12	200 to 240	2 to 4	40 to 80	12 to 16	240 to 320
Thomas Slag (American)	6 to 7	120 to 140	12 to 13	240 to 260	18 to 20	360 to 400

(c) *Fertilizing Materials Containing Potash Compounds.*

The more common sources of potash compounds for use as fertilizers, found in the market, are the following: *Carnallite, cotton seed hull ashes, green sand marl, kainit, krugite, muriate of potash, nitrate of potash, sulphate of potash, sulphate of potash and magnesia, tobacco stems, wood ashes, etc.*

Wood ashes formerly constituted the main source of potash compounds in our agriculture, aside from what was furnished by farm manures. But for some years past the chief source of potash supply has been the different compounds obtained from the German potash mines at Stassfurt in northern Germany. The deposits are so extensive as to appear inexhaustible.

CARNALLITE is one of the products of the German potash mines. It contains from 20 to 22 per cent. of muriate of potash, equivalent to 13 to 14 per cent. of actual potash, together with chloride of magnesia and a very small amount of sulphate of potash and magnesia. It is essentially a mixed chloride or muriate of potash and magnesia. The material is generally purified and concentrated before reaching market.

KAINIT is the most common product of the German potash mines. It is a mixture of several different compounds, containing 23 to 26 per cent. of sulphate of potash, equivalent to 12 to 14 per cent. of actual potash, together with about 35 per cent. of common salt, some sulphate and chloride of magnesia and a small amount of gypsum.

KRUGITE is a low-grade potash compound obtained from the German potash mines. It contains from 14 to 16 per cent. of sulphate of potash, equivalent to 8 or 9 per cent. of actual potash, together with considerable gypsum, sulphate of magnesia and some salt.

MURIATE OF POTASH, also a product of the Stassfurt mines, is the main source of supply of potash for commercial fertilizers in our market. As taken from the mine it varies in purity, but is purified and concentrated for market. The muriate of potash most common in the market contains 80 to 85 per cent. of this product, which is equivalent to 50 to 53 per cent. of actual potash. A still more concentrated form, containing 95 to 98 per cent. of pure muriate, is sometimes found in the market.

SYLVINIT resembles kainit, containing about 15 to 16 per cent. of actual potash in the form of both sulphate and chloride. It also contains chlorides of sodium and magnesium. It is little used in this country.

SULPHATE OF POTASH is another product of the German mines. Strictly pure sulphate of potash contains about 54 per cent. of actual potash, but the product found in the market is of variable composition and purity. The highest grade of commercial sulphate of potash is 90 to 95 per cent. pure and contains from 48 to 51 per cent. of actual potash. Low-grade sulphates contain as little as 30 per cent. of actual potash, together with more or less sulphate of magnesia and common salt.

SULPHATE OF POTASH AND MAGNESIA is known also as double manure salts or simply as double potash salts. This material comes from the German mines, and contains 48 to 52 per cent. of sulphate of potash, equivalent to 26 to 28 per cent. of actual potash. It also contains 32 to 36 per cent. of sulphate of magnesia.

NITRATE OF POTASH, commonly called saltpeter or nitre, is a most valuable fertilizing material for potash and nitrogen also. The demand for its use in the manufacture of gunpowder makes it too expensive to use commonly as a fertilizer. It is found in the market as "crude" nitrate of potash, containing about 44 per cent. of actual potash, and also as "double refined" nitrate of potash, containing about 46.5 per cent. of actual potash.

COTTON SEED HULL ASHES were produced in the South at the cotton seed oil factories, where the hulls, after being removed from the cotton seed, were used as fuel. Such ashes contain from 15 to 25 per cent. of potash, in addition to from 7 to 10 per cent. of phosphoric acid. They formed a very valuable fertilizer and were much used South in the manufacture of commercial fertilizers. This material is not commonly found now.

TOBACCO STEMS contain from 6 to 7 per cent. of potash and about two per cent. of nitrogen. They are ground fine and often used in making commercial fertilizers.

WOOD ASHES contain more or less potash, which is present chiefly in the form of carbonate. The amount of potash in commercial wood ashes varies from below 4 to 7 per cent., the average being under five per cent. Wood ashes also contain between 1 and 2 per cent. of phosphoric acid. The amount of potash in wood ashes depends upon a variety of conditions, such as the kind and age of wood, the method of burning, and especially the way in which the ashes are stored. Where ashes have been exposed to the weather or leached, they contain much less potash, often only 1 or 2 per cent. Ashes from lime-kilns and brick-kilns are generally so mixed with refuse matter as to possess little value for use as fertilizers. Coal ashes possess little value for the potash contained in them, for it is very small.

GREEN SAND MARL of New Jersey contains, on an average, about five per cent. of potash, which is in an insoluble form, and is, therefore, slow in acting as a fertilizer.

Below we present a tabulated summary, showing the amount of potash contained in different commercial fertilizing materials:

Approximate Amount of Potash in Fertilizing Materials.

Materials Containing Potash.	**Per cent. of actual potash.**	**Pounds of actual potash in 2,000 pounds of material.**
Carnallite	13 to 14	260 to 280
Cottonseed-hull ashes	15 to 25	300 to 500
Kainit	12 to 14	240 to 280
Krugite	8 to 9	160 to 180
Muriate of potash (80 to 85 per cent.)	50 to 53	1000 to 1060
Nitrate of potash	43 to 44	860 to 880
Sulphate of potash (low grade)	28 to 30	560 to 600
Sulphate of potash (high grade)	48 to 51	960 to 1020
Sulphate of potash and magnesia	26 to 28	520 to 560
Sylvinit	15 to 16	300 to 320
Waste from powder works	16 to 18	320 to 360
Wood ashes (unleached)	4 to 8	80 to 160
Wood ashes (leached)	1 to 3	20 to 60

(*d*) *Farm-Produced Fertilizing Materials.*

ECONOMIC VALUE OF FARM MANURES.— A fair estimate of the fertilizing value of the manure annually produced by the farm animals of the United States places the sum at the enormous figure of over two thousand million dollars. This estimate is based on the number of farm animals and on the amount of nitrogen, potash and phosphoric acid excreted in their manure. The values given to these forms of plant food are those commonly assigned to them in the form of commercial fertilizers. It will thus be readily seen that the farm-produced manures assume an economic importance which has not been accorded them by the average farmer.

DEFINITION OF STABLE OR FARMYARD MANURE.— Stable or farmyard manure consists of the solid and liquid excrements of animals fed upon the farm, mixed or unmixed with straw and waste products of the farm.

VARIATION IN COMPOSITION OF FARM MANURES.— The composition of stable manure varies greatly, depending on several conditions, among which the following may be mentioned:

(1) The kind and age of the animal producing it.
(2) The quantity and quality of the food eaten.
(3) The character and amount of material used for litter.
(4) The length of time the manure has been kept.
(5) The manner in which it has been cared for.

INFLUENCE OF KIND OF ANIMAL ON MANURE.— *Horse Manure* is difficult to mix thoroughly with litter on account of its being very dry. It is called a " hot " manure, because, on account of its loose texture, it easily undergoes decomposition or fermentation, producing a high degree of heat. On this account it is very liable to lose more or less of its nitrogen in the form of ammonia. It should have very careful treatment in respect to the litter used and also in the application of preservatives. It is a quick-acting manure. Horses are usually fed with greater uniformity in respect to character of food than other farm animals and there is, therefore, greater uniformity in the composition of horse manure. The urine of horses is particularly rich in nitrogen and potash. It has been estimated that horses excrete somewhat over half their manure in the stable, or, on an average, about six tons a year.

Sheep Manure is quite dry and is commonly the richest of farm-produced manures. Like horse manure, it undergoes fermentation easily and is classed as a " hot " or quick-acting manure. It is similarly very liable to lose ammonia.

Pig Manure varies greatly in composition, but is generally rich, though containing considerable water. In decomposing, it produces little heat and is, therefore, called a " cold " manure. It is classed as a slow-acting manure. When pigs are well fed, their liquid excrement is rich in nitrogen.

Cow Manure contains as a rule, less fertilizing materials than any of the preceding manures. It contains a large amount of water, and, in decomposing, generates little heat and is slow acting. A well-fed cow, producing milk, excretes 20 to 30 pounds of liquid manure and 40 to 50 pounds of solid manure. About one-half of the nitrogen produced is in the urine.

Poultry Manure contains a comparatively large amount of all the different forms of plant food, being especially rich in nitrogen and potash. It undergoes fermentation readily and loses nitrogen unless properly treated with absorbents or preservatives. It is a very quick-acting form of plant food. A single hen produces 40 to 60 pounds a year of manure.

INFLUENCE OF AGE OF ANIMAL ON MANURE.— A young, growing animal requires and retains in its body a greater quantity of nitrogen, potash and phosphoric acid compounds than does a grown animal. Therefore, manure from a young animal is of less value than that from a mature one. Full-grown animals, not varying in weight, excrete essentially all the fertilizing constituents taken into the body in the food. In the case of growing animals and cows in milk, from 50 to 75 per cent. of the fertilizing constituents of the food passes into the manure; in the case of fattening or working animals, from 90 to 95 per cent.

INFLUENCE OF FOOD UPON MANURE.— In the case of any one class of animals, the value of the manure is, as a rule, more dependent upon the kind of food than any other one condition. It is a serious but not uncommon mistake among farmers to suppose that the process of animal digestion *adds something* to the food. While the food materials are changed more or less completely and appear in the dung and urine in forms different from those existing in the food before it was eaten, and while these forms are, in general, more available as plant food than the forms existing in the original food, still there can be in the excrement no more nitrogen, potash, phosphoric acid, etc., than there was in the food eaten, and, in most cases, as will be noticed later, there is some loss of fertilizing materials.

Relative Value of Fertilizing Materials in Different Classes of Foods.— The amount of nitrogen, phosphoric acid and potash in manure depends upon the amount of these materials in the food. From the table given below, it can be seen that concentrated foods, such as meat scrap, cotton seed meal, linseed meal and wheat bran must yield richest manures. Next to these foods would come leguminous plants, such as clover, alfalfa, etc. The cereals, such as wheat, oats, corn, etc., would follow third. Root crops would come last.

TABLE Showing Approximate Fertilizing Value of Some Common Foods.

Kind of Food.	Value of nitrogen in 2,000 pounds.	Value of phosphoric acid in 2,000 pounds.	Value of potash in 2,000 pounds.	Total fertilizing value in 2,000 pounds.
Meat scrap	$32 00	$2 00	......	$34 00
Cotton seed meal	18 60	2 15	$1 45	22 20
Linseed meal	16 10	1 50	1 15	18 75
Gluten meal	14 00	25	5	14 30
Wheat bran	7 40	2 35	1 30	11 05
Clover hay (red)	5 90	40	1 60	7 90
Alfalfa hay	6 15	45	1 35	7 95
Wheat	6 60	65	45	7 70
Oats	5 60	65	50	6 75
Corn meal	4 90	55	35	5 80
Timothy hay	3 00	35	1 25	4 60
Wheat straw	1 45	10	40	1 95
Skim milk	1 60	30	20	2 10
Corn ensilage	65	10	30	1 05
Turnips	50	10	30	90

It will be readily seen that of two foods costing the same price and having equal feeding value, it is economy for the farmer to use that one which contains the largest amount of fertilizing materials.

Amount of Fertilizing Materials of Food Recovered in Manure. — Generally speaking, manure produced from working or fattening animals contains from 90 to 95 per cent. of the fertilizing constituents contained in the food. Manure made from cows in milk and young, growing animals contains from 50 to 75 per cent. of the fertilizing constituents contained in the food. In the case of animals which are neither increasing in weight nor giving milk, the amount of fertilizing materials in the manure will be exactly equal to that contained in the food eaten. The foregoing statements presuppose that all the dung and urine are saved, a supposition which is not often true, considering the manner in which stable manure is commonly treated.

The Digestibility of Food and Its Manurial Value.— The solid excrements of animals consist largely of the undigested portions of food; these undigested portions are mostly insoluble and, therefore, not immediately available as plant food. The urine contains those portions of food which have been digested; its constituents are all in a soluble form and readily available as plant food, and, therefore, more valuable than the insoluble fertilizing materials contained in the solid excrement. It therefore follows that the more digestible a food is, the larger is the proportion of its fertilizing constituents that will appear in the urine, and the greater will be the value of the plant food in the manure produced.

THE USE OF LITTER.— Litter is used in stables primarily to furnish a clean and comfortable bed for animals. In connection with the manure, it is used to absorb the liquid portion of the manure, thus preventing loss by drainage. The presence of litter mixed with manure makes the manure easier to handle, tends to check and control its decomposition, and in some cases influences both the physical and chemical action of the manure. The materials commonly used for litter are usually not rich in fertilizing materials. The use of too much litter diminishes the relative value of the manure and adds to the cost of handling. Enough should be used not only to absorb and retain the urine, but also to absorb any ammonia formed in the process of decomposition.

FERMENTATION OF MANURE.— *Causes.*— It is a familiar experience of every farmer that fresh stable manure, when left in a heap, commences very soon to ferment or undergo decomposition. In this process the vegetable matter used as litter and the excrements pass through several changes. The fermentation is caused by minute living organisms, and varies according to the kind of organisms at work. Some will flourish only in the presence of an abundant supply of air, others will thrive only away from air; some require much moisture, others little, etc. According to circumstances, then, one kind or another will flourish, and the fermentation taking place will vary according as it is caused by the action of one kind of organism or another.

Conditions.— The more important conditions influencing the character of fermentation in manure are the following: (1) Temperature, (2) moisture, (3) the amount of air supplied as regulated by looseness or compactness of manure heap, (4) the composition of the manure, and (5) the kind of preservatives added.

Manure ferments more quickly at higher temperatures. Where air is supplied freely, as on the outside of the heap, the temperature may rise as high as 150 degrees Fahrenheit or even higher. The most favorable temperature seems to be about 130 degrees Fahrenheit. On the inside of the heap, where the supply of air is very limited, a slower form of fermentation occurs and the temperature rarely goes above 95 degrees Fahrenheit.

If a manure heap is too loose, the fermentation is too rapid. The result is that the humus-forming material is destroyed and large proportions of nitrogen escape as ammonia. If, however, the manure is too compact, the fermentation may be so slow as not to decompose the manure enough for its most effective use in the soil.

The amount of moisture in manure is an important factor in controlling the rapidity of fermentation. The addition of water causes reduction of temperature and a corresponding slowness of fermentation. Water, when added in sufficient quantities, also fills up the pores of the heap and serves to exclude air, thus retarding the most active form of fermentation.

Manures which are rich in soluble nitrogen decompose more readily than others which contain less soluble nitrogen. Thus urine decomposes much more rapidly than solid excrement.

Changes Produced by Fermentation.— The principal changes that take place in the more common methods of fermentation or "rotting" of manure may be briefly outlined as follows: (1) The carbon of the manure combines, to a greater or less extent, with the oxygen of the air, forming carbon dioxide (carbonic acid gas), which escapes into the air. (2) The nitrogen combines with hydrogen to form ammonia. If the manure heap is dry, the ammonia combines with carbon dioxide, forming ammonium carbonate, which may escape into the air and be lost to the manure. If the heap is kept moist, certain organic acids are formed by the decomposition of the organic matter, and the ammonia, as fast as it is formed, unites with these acids, producing ammonia salts which readily dissolve in water, but which do not escape as gases into the air. (3) Considerable water is driven off from the manure by the heat which is produced in the process of fermentation. (4) In the inner part of the heap, which is shut off from the air, there is serious danger that nitrate-destroying germs will decompose the nitrates and thus cause their loss.

Difference between Fresh and Fermented Stable Manure.— From the foregoing it would follow that fresh stable manure differs from fermented or "rotted" stable manure in the following respects: The fresh manure contains (1) more water, and (2) more carbon than the fermented manure; while (3) both contain in their dry matter the same amount of potash, phosphoric acid and nitrogen, provided the process has been carefully managed. In "rotted" manure, (4) the nitrogen is in a more available form as plant food; the same is also true of the potash and phosphoric acid. (5) If the process of rotting is allowed to go too far the nitrates will be changed into free nitrogen and lost.

Between two and three tons of fresh mixed stable manure are required to produce one ton of half-rotted manure. The difference in weight is due mainly to water and carbon.

Manure that is very completely rotted so as to form a black, uniform, sliny mass has usually lost most of its nitrate nitrogen. Half-rotted manure is the form in which stable manure is quite commonly used. It contains nitrate nitrogen and is in its most available form.

LOSS OF FERTILIZING MATERIALS IN STABLE MANURE.— There are two principal ways in which stable manure commonly loses some of its fertilizing constituents: First, by improper methods of fermentation, and second, by leaching. In regard to the first point, more or less nitrogen is lost by allowing manure to ferment without sufficient moisture; especially is this apt to be true in the case of the manure of horses, hens and sheep, which decomposes very rapidly. A strong odor coming from a manure heap indicates that a wasteful fermentation is taking place. Of plant food materials only nitrogen compounds can be lost by vaporization. By leaching there will be a loss, not only of nitrogen compounds, but of potash and phosphoric acid also. The common method of storing farmyard manure for several months under the eaves of the barn generally results in a loss of one-third or more of the fertilizing constitutents by leaching; and, moreover, the materials thus leached out by rain are the more easily soluble portions of the manure, and hence the more valuable portions.

CARE AND PRESERVATION OF FARM MANURES.— In caring for farm manures, the main object is to prevent the loss of compounds containing nitrogen, potash and phosphoric acid. From what has been said above in connection with the sources of loss of fertilizing materials in farm manures, it can be seen that the causes of loss can be avoided by absorbing the liquid manure, by regulating the process of fermentation and by protecting the manure from leaching. We will consider briefly some of the ways in which these objects can be accomplished.

The use of litter absorbs the liquid manure, preserves it to some extent from immediate decomposition, and also holds more or less of the ammonia produced by fermentation, thus preventing its escape into the air. Of the materials in common use, *peat* has the largest power of absorbing and holding liquids; peat moss comes next; spent tan and sawdust follow; then come straw and similar materials. It has been given as a safe rule to follow that the litter should at least be equal to one-third of the dry matter of the food consumed. The following daily amounts for different animals have been suggested: Sheep, three-fifths of a pound of litter; cattle, nine pounds; horses, six and one-half pounds. In addition to using litter, it is wise to use some other materials for absorbing and preserving the manure. Among such materials are gypsum (land plaster), kainit, acid phosphate, etc.

Gypsum (land plaster) has the power of holding ammonia and preventing its loss. It must, however, be moist in order to be effective. The best way to use gypsum is to sprinkle it on the moist dung or urine. Stables in which the excrements are properly treated by this means are noticeably free from offensive odors, as a rule.

Kainit sprinkled upon manure tends to check fermentation and also to attract and hold moisture. One precaution should be observed in the use of kainit; it should be kept from under the feet of animals, since injury may result to the feet of animals treading on it. It is, therefore, best applied to fresh manure and covered with litter.

Acid Phosphate contains a considerable proportion of gypsum and, to this extent, its action is like that of gypsum. The soluble phosphate in the acid phosphate tends to unite with ammonia and prevent its loss and also to check fermentation.

A mixture of acid phosphate and gypsum is strongly recommended by some, using them in about equal proportions.

For average animals, the following amounts of different preservatives may be used daily for each individual:

Kind of Preservative.	**For one horse —pounds.**	**For one cow—pounds.**	**For one pig—ounces.**	**For one sheep —ounces.**
Gypsum (land-plaster)	**1½**	**1¾**	**4½**	**3½**
Acid phosphate	**1**	**1⅛**	**3**	**2½**
Kainit	**1⅛**	**1¼**	**4**	**3¼**

When a mixture of superphosphate and gypsum is used, take one-half or one-third of the amounts indicated above. One great advantage in using acid phosphate or kainit is that one is adding to the manure an important form of plant food, in which the manure is naturally deficient. The price at which one can get these materials must determine whether their use is economical or not.

Mixture of different manures, such as cow and horse manures, is advantageous, since one undergoes fermentation slowly and the other rapidly. When mixed, the conditions of moisture are more easily controlled.

Whether stable manure is stored in sheds, or in cellars or is protected in some other way, it is important to observe the following precautions: (1) The manure should be spread out uniformly; (2) its interior should be protected against the access of air; (3) it should be kept always moist, but not too wet; (4) it should be protected from sunshine; (5) it should be protected from leaching; (6) some form of preservative should be used in the stables in addition to litter.

LIQUID AND SOLID MANURE.— It is not an uncommon belief among farmers that urine is worthless for fertilizing purposes, if we may judge anything from the too general practice of allowing the liquid excrements to run to waste through the barn floor. One has only to glance at the composition of the solid and liquid excrements of different animals as given below to see that the liquid is, in most cases, very much more valuable than the solid portions. Not only are the proportions of nitrogen and potash greater, as a rule, in the liquid excrement than in the solid, but, as already noticed, the fertilizing constituents of urine are entirely soluble and therefore more readily available for plant food than the constituents of solid excrements.

TABLE Showing Approximate Composition of Solid and Liquid Manures.

	Pounds of Nitrogen in 100 Pounds.		Pounds of Phosphoric Acid in 100 Pounds.		Pounds of Potash in 100 Pounds.	
	Solid.	Liquid.	Solid.	Liquid.	Solid.	Liquid.
Cows	0.30	1.30	0.28	0	0.20	1.00
Horses	0.60	1.55	0.30	0	0.50	1.50
Sheep	0.80	1.95	0.25	0	0.65	2.25

TABLE Showing Approximate Composition of Mixed Stable Manure.

	Per cent. of nitrogen.	Pounds of nitrogen in one ton.	Per cent. of phosphoric acid.	Pounds of phosphoric acid in one ton.	Per cent. of Potash.	Pounds of potash in one ton.
Least	0.4	8	0.2	4	0.4	8
Greatest	0.75	15	0.4	8	0.75	15
Average	0.50	10	0.25	5	0.50	10

PART III.

THE PURCHASE AND USE OF FERTILIZERS.

One of the questions most commonly asked by farmers seeking information is, "What fertilizer will give me the best results for this or that crop?" It is, of course, impossible to give any definite answer to such a general question involving, as it does, so many different conditions, none of which is clearly known. The composition and physical properties of the soil, the extent and manner in which it has been previously cropped and fertilized, the kind of crop one wishes to grow — all these conditions need to be known and, even then, it will require some special experimenting on the part of the farmer to determine what forms and amounts of fertilizers he can use most economically. The common method employed by farmers in selecting fertilizers is to take some brand of complete fertilizer that has been recommended to him by some neighbor or dealer. He has no clear ideas regarding the condition of his soil, and the needs of different crops. He thinks that he must have more fertilizer in order to secure better crops and he buys blindly. Under such circumstances, it is safest, as a rule, for a farmer to select a complete fertilizer. However, in so doing, he may be throwing money away by purchasing what his soil and crop may not need, for only one or two of the three chief fertilizing constituents (nitrogen, potash and phosphoric acid) may be needed; and, indeed, it may be that some physical condition of the soil is wrong and that plant food of any kind is not really needed at all.

In selecting fertilizers for use, we need to consider several important questions, such as the following:

1. Under what circumstances a fertilizer should be used.
2. What constituents of plant food are needed.
3. What amount of each fertilizing constituent is needed.
4. In what forms it is best to buy such plant food as is needed.
5. Which is more advantageous, to purchase complete fertilizers or to purchase separate ingredients?
6. To what extent home-mixing is practicable.
7. Special suggestions in connection with the purchase of separate ingredients.
8. Methods and seasons of applying fertilizers.

9. The most advantageous methods of using farm-produced manures.
10. The use of green manures.
11. Rotation of crops.
12. The use of lime on soils.
13. Plant-food mixtures for different crops.

1. UNDER WHAT CIRCUMSTANCES SHOULD A COMMERCIAL FERTILIZER BE USED?

One must resort to the use of commercial fertilizers when he has exhausted all of the resources of the farm in producing his own fertilizing materials and finds that the use of commercial fertilizers will result in increased crops and profit. When the farmers' crops cannot get from the soil as much nitrogen, potash and phosphoric acid as they need, and when the manure made on the farm cannot supply the constituents in sufficient quantity, then one may resort successfully to the use of commercial fertilizers. One must secure an increase of crop sufficient to pay for the fertilizer used and for the cost of labor in applying it, and have something in addition in order to make the use of commercial fertilizer a paying operation.

However, one must distinguish between lack of plant food in the soil and other conditions which prevent good crops, for lack of food is not the only cause that makes crops suffer. In some soils there is, for example, a tendency to harden, causing lack of porosity, which prevents the development of roots and thus limits the feeding power of the plant. Such condition may be overcome by adding humus to the soil, together with proper tillage. Other unfavorable conditions may be lack of moisture, retention of stagnant water, deficiency of lime, acidity of soil, climatic influences, etc., which may interfere with the healthy growth of plants and thus cause diminished crops, even when the plant has within reach all the food it needs. Under such circumstances, the unfavorable conditions must, if possible, be removed to secure good crops; and this, according to the demands of special cases, may be done by irrigating, draining, deep culture, better plowing, harrowing, hoeing, marling, liming, mucking, etc.

It often happens that a soil contains an abundance of plant food, most of which is in unavailable forms. Under such circumstances an effort should be made to bring this food into an available condition as rapidly as plants can use it. Briefly stated, this can be done to some extent by the use of indirect fertilizers, like gypsum, lime and salt; by the use of organic manures; by growing deep-rooting crops; by judicious use of drains, and by vigorous and thorough tillage.

It cannot be too strongly emphasized that, before one can advantageously approach the question of the economic use of commercial fertilizers, he must make sure that all those conditions of soil are present which are essential to the favorable growth of crops, in addition to plant-food supply.

It will thus be seen that it is not always so simple a matter to tell when one should use commercial fertilizers. But the general rule will be to use them when their use is attended with increased profit coming from increased crops, and this can be learned with certainty only by actual trial. Attention will be called later to specific methods for making field tests.

2. WHAT CONSTITUENTS OF PLANT FOOD ARE NEEDED.

When it has been clearly settled that a soil needs the addition of plant food in order to grow crops more successfully, the question at once presents itself as to what kinds of plant food are required. Does some form of nitrogen need to be supplied, or is it phosphoric acid that is needed, or is it potash? It may be only one, it may be some two, or it may be all three of these constituents are necessary to grow crops to the best advantage. *How can we ascertain what kind of plant food is required?*

ANALYSIS OF SOILS.— It was formerly thought that an analysis of the soil would answer this question beyond doubt. But it is now known not to be especially helpful except, perhaps, in a negative way by making known the fact when there is little or no plant food in the soil. A chemical analysis may show an abundance of plant food in the soil, and yet this may be mostly unavailable, a fact which is not readily ascertained by our methods of chemical analysis. Again, there may be an abundance of nitrogen, potash and phosphoric acid compounds in the soil in an available condition, and yet the soil may be unproductive from lack of humus, from need of proper drainage, from lack of porosity or from some other cause which affects the mechanical or physical condition of the soil in such a way as to unfit it for plant growth. Again, we may put upon an acre of soil an amount of fertilizing constituents that will greatly increase the crop, and yet an analysis of the soil before and after the application will show no appreciable difference in the quantity of plant food present in the acre of soil. However delicate may be the methods of chemical analysis, the methods of plants are still more delicate, and plants are able to show differences in soil where chemical analysis distinguishes none.

INDICATIONS OF NEEDS OF SOIL AFFORDED BY APPEARANCE OF CROPS.— It is impossible to give any fixed rules which will cover all cases and enable a farmer to tell without any experiment on his part what food constituents his soil lacks. In a general way, the crops themselves may give some valuable suggestions.

(*a*) As a rule, *lack of nitrogen* is indicated, when plants are pale green in color, or when there is a small growth of leaf or stalk, other conditions being favorable.

(*b*) A bright, deep green color, with a vigorous growth of leaf or stalk, is, in case of most crops, a sign that *nitrogen is not lacking* but does not necessarily indicate that more nitrogen could not be used to advantage.

(*c*) An excessive growth of leaf or stalk, accompanied by an imperfect bud, flower, and fruit development, indicates *too much nitrogen* for the potash and phosphoric acid present.

(*d*) When such crops as corn, cabbage, grass, potatoes, etc., have a luxuriant, healthful growth, *an abundance of potash* in the soil is indicated; also, when fleshy fruits of fine flavor and texture can be successfully grown.

(*e*) When a soil produces good, early maturing crops of grain, with plump and heavy kernels, *phosphoric acid will not generally be found deficient* in the soil.

Such general indications may often be most helpful, and the condition of crops should be studied carefully with these facts in mind.

PLANT-FOOD NEEDS IN RELATION TO KIND OF SOIL.—The kind of soil may furnish information as to what kind of plant food is apt to be lacking. While soils of the same class differ widely in composition, there are certain general suggestions which they may afford. In *sandy* soils potash is commonly deficient and hence this element must be a prominent ingredient of a fertilizer for such a soil. Sandy and gravelly soils usually require liberal amounts of phosphoric acid also, owing to the fact that in such soils phosphate compounds are liable to leach beyond reach of plants. On the other hand, *clay* soils are usually well supplied with potash and are apt to be deficient in phosphoric acid and lime. In *lime* soils there may be a lack of nitrogen.

PLANT-FOOD NEEDS OF SOILS IN RELATION TO PREVIOUS CROPS. — The growing of the same kind of crop continuously on the same land is exhausting in regard to one or more elements of plant food. Thus, wheat grown year after year on the same soil exhausts nitrogen and phosphoric acid more rapidly than potash; hence, phosphoric acid and nitrogen without potash would, in most such cases, give fully as good results as with potash, at least for a time. The continuous growth of grass crops takes large amounts of potash compared with phosphoric acid. Where there has been such a system of farming employed, one element will usually be found to have been removed more extensively than others, and in feeding crops, this lacking element is the one that especially needs to be supplied.

It often happens that in a system of rotation all elements of plant food are removed in about the same proportion, and hence restoration of high productiveness means addition of nitrogen, phosphoric acid and potash.

PLANT-FOOD NEEDS OF SOILS IN RELATION TO SPECIFIC CLASSES OF PLANTS.— The food needs of different classes of plants vary in a marked degree and their general requirements should be studied if we try to feed them intelligently. For the purpose of calling attention to the main facts, we can divide most of our common crops into the following classes:

Root and tuber crops, grasses, leguminous crops, cereals, fruit crops, market-garden crops.

(*a*) *Root and Tuber Crops* include such crops as turnips, beets, mangels, carrots, potatoes, sweet potatoes, etc. While these crops need all elements of plant food, turnips appear to make especially good use of available phosphoric acid in their early stages of growth. Beets and carrots grow less quickly and need nitrogen in readily available forms. Potatoes need liberal supplies of available potash. These crops, owing to their habits of growth, do not make quick use of the insoluble mineral plant food of the soil, especially in their early stage of growth.

(*b*) Grasses are mostly perennial, though their length of life depends upon a variety of conditions, such as methods of cropping, kind of soil, etc. They are mostly surface feeders in their early stages of growth. They have the power of using potash and phosphoric acid in its less soluble forms quite easily. It is of advantage, however, to supply them with easily available forms of nitrogen which should be fed them quite liberally, because the object of the crop is leaf and stem for pasture or hay or forage, and nitrogen promotes this form of growth.

(*c*) *Leguminous Crops* such as clover, peas, beans, vetches, etc., have the power of securing nitrogen from the air, but need very liberal supplies of potash and phosphoric acid.

(*d*) *Cereals* possess certain marked characteristics in their methods of growth and feeding. Their roots branch just beneath the surface and each separate shoot sends out feeding roots in every direction, thus reaching the lower layers of the soil in the later stages of growth. Their peculiar root system enables cereals to feed quite readily upon the less soluble potash and phosphoric acid compounds of the soil. A considerable part of the growth of many of these crops occurs early in the season before the unavailable nitrogen is changed into nitrates, and, therefore, they are, with the exception of Indian corn, greatly helped by early applications of nitrate-nitrogen. Hence, early application of nitrate-nitrogen helps wheat, rye, oats and barley. With corn, the growth comes largely after other cereals have ripened, in July and August, and by this time the insoluble soil nitrogen has changed largely into nitrates.

(*e*) *Fruit Crops.*— Fruit trees are slow in growth and slow feeding; hence they can utilize less available forms of plant food. Their supplies of food should be of such a character as to favor slow and continuous rather than rapid growth. For example, ground bone is a good source of nitrogen and phosphoric acid.

(*f*) *Market-Garden Crops* include many crops greatly varying in their feeding habits, but they are all raised with one object in view — to secure tenderness and succulence by means of very rapid growth. This is secured by large applications of nitrate-nitrogen along with very liberal quantities of potash and phosphoric acid.

In order to ascertain with greater certainty what food elements are lacking in the soil, the surest way is for each farmer to do some experimenting on his own soil and crops. The exact manner of doing this will be considered under the following head in connection with the amount of plant food to be used.

3. WHAT AMOUNT OF EACH FERTILIZING CONSTITUENT IS NEEDED.

Inseparably connected with the question of what elements of plant food are needed is the question, "How much of each element is needed?" Perhaps, the question more often asked than any other relates to the quantities in which fertilizers should be applied. Granting that we know fairly well whether we need to use nitrogen, or phosphoric acid or potash compounds, or some combination of these, how can we ascertain how much to put on an acre of land? This question is quite as complicated as the preceding one. A variety of conditions must be considered. If we knew how much available plant food there were in an acre of soil, and how much the growing crop would require, the matter would be comparatively simple, provided the mechanical condition of the soil was satisfactory. The form of fertilizing material used would also need consideration.

There are two extremes which we must strive to avoid. On the one hand, we can assume that the supply of food in the soil is fairly abundant and make only small additions, thus running the risk of using too small amounts for growing a good crop. On the other hand, we may assume that the supply of food in the soil is decidedly deficient and put on quantities of fertilizing material sufficient in itself to grow a good crop. In this case, we run the risk of putting on more than the present crop needs. If we cannot hit upon the desired medium, putting on amounts that will grow the best crop most economically without leaving too much plant food over, it is better to make the mistake of putting on too much than too little. Only individual experimenting can determine in each case how much nitrogen, potash, and phosphoric acid can be used to best advantage, and to this line of work attention will now be given.

EXPERIMENTS IN LEARNING PLANT FOOD NEEDED.— In order to ascertain with certainty what food elements are lacking in the soil, the surest way is for each farmer to do some experimenting on his own soil and crops. In fact, if farmers are unwilling to carry out some simple experiments for themselves on their own farms and with their own crops, they cannot expect ever to make use of plant food in the most economical and intelligent manner.

It is our purpose now to indicate in some detail how such experimenting can be done by individual farmers.

(*a*) *Selection of Land for Field Tests.*— The land selected for testing plant-food needs should be in good condition in respect to tillage, drainage, etc. The soil should be as much alike as possible throughout the test field. It is desirable also that the surface shall be quite level and uniform. The more worn-out the soil is, the more definite results may be expected.

(*b*) *Size of Experimental Plots.*— A convenient size of plot to use for a field test is one-twentieth of an acre, containing an area of 2,176 square feet. The length and breadth of the plots can be such as suits one's convenience, but it is recommended that each plot measure 204 feet in length by 10 feet 8 inches in width. Between the plots, leave a strip unused three or four feet wide so as to avoid any possible mixing of the different plots.

(*c*) *Preparation of Land.*— Select a portion of the field that represents a fair average, and that has been cropped and manured alike previously; prepare the soil as carefully as possible for the crop and then *measure accurately* and stake out into plots 204 feet long, and 10 feet 8 inches wide, leaving between the plots a strip three or four feet wide. Mark each plot by a number corresponding to the kind of fertilizer used, following a diagram previously laid out on paper.

(*d*) *Application of Fertilizer.*— Distribute each fertilizer over its own plot, mixing it thoroughly with the soil and keeping the fertilizer from going outside the plot. It is better to apply the fertilizer broadcast and before planting, if the crop is not a cultivable one. For cultivable crops the fertilizer may be applied after planting and harrowed in. On the basis of the amounts of fertilizer given below, there will be one pound of fertilizer or an even multiple of it for each square rod of surface.

(*e*) *System in Conducting Fertilizer Experiments.*— The work must be done from beginning to end, systematically and accurately, if best results are to be obtained. The harvested crop must be carefully measured and a record kept of all results.

(*f*) *Plan of Experiment.*— The following diagram represents an arrangement of plots, together with the kinds and amounts of plant-food materials to use. The particular crop with which to experiment may be left to the choice of the farmer. For first trials, corn, or potatoes, or oats may be used, to be followed by such others as are usually raised by the farmer. The work should be carried on for more than one season. It must be kept in mind that weather conditions may seriously interfere to destroy the value of the results. An excessively dry season works against satisfactory results. Therefore, the work should be repeated. All the plots should receive the same amount and kind of cultivation. The same amount of seed should be used. In a word, keep all conditions of treatment as much alike as possible, except for the application of fertilizers.

Plot No. 1	Blank	No fertilizer.
Plot No. 2	Eight pounds	Nitrate of soda.
Plot No. 3	Sixteen pounds	Dissolved rock.
Plot No. 4	Eight pounds	Muriate of potash.
Plot No. 5	Eighty pounds	Air-slaked lime.
Plot No. 6	Eight pounds	Nitrate of soda.
	Sixteen pounds	Dissolved rock.
Plot No. 7	Eight pounds	Nitrate of soda.
	Eight pounds	Muriate of potash.
Plot No. 8	Sixteen pounds	Dissolved rock.
	Eight pounds	Muriate of potash.
Plot No. 9	Eight pounds	Nitrate of soda.
	Sixteen pounds	Dissolved rock.
	Eight pounds	Muriate of potash.
Plot No. 10	Blank	No fertilizer.
Plot No. 11	Two hundred and fifty pounds.	Stable manure, well-rotted.
Plot No. 12	Two hundred and fifty pounds.	Air-slaked lime.

It may be desirable the first year to limit the work to the first five plots, and then extend it as experience is acquired.

(*g*) *Interpretation of Results.*— If Plots No. 1 and No. 10 give as good results in crops as any other, then the soil is in good condition as regards its present plant-food supply. If Plot No. 2 gives increased yields, the need of nitrogen is indicated. An increase of crops on Plot No. 3 indicates need of available phosphoric acid, and increase on Plot No. 4 shows need of potash. Increase of crops on Plots No. 5 and No. 12 shows probable acidity of soil or presence of unavailable potash compounds in soil or else lack of lime sufficient for plant food. If Plot No. 11 gives better results than other plots, there is probably a lack of humus in the soil. If Plot No. 6 shows no increase of crop, then nitrogen and phosphoric acid are not deficient in soil. The other plots are to be interpreted similarly in accordance with the behavior of crops.

The amounts of plant-food materials indicated above are larger than will be used on many soils and crops. But when once it is found that any particular element of plant food increases a crop, then some additional trials can be made to ascertain the smallest amount of application that will give most economical results. The factors that determine the amount of plant food needed are: (1) the amount of available plant food present in the soil, (2) the amount of plant food required by the crop grown, and (3) the kind of farming carried on.

HOW CAN WE DETERMINE THE AMOUNT OF AVAILABLE PLANT FOOD PRESENT IN THE SOIL?— The method given above is essentially the only practicable and reliable means we have at present for ascertaining whether or not there is in a soil enough available plant food of any particular kind to grow a crop satisfactorily. As already pointed out this information cannot be gained with certainty by a chemical analysis of soil. Farmers cannot be too strongly impressed with the necessity of carrying out some such experiments as those indicated above. Such experiments can be carried on with very little extra work. This line of work, properly conducted, will not only furnish the farmer information that is of the greatest practical and economical value to him, but it will exert a marked educational influence upon him, making him personally familiar with plant-food materials, causing him to take a deeper interest in the growing of crops, and leading him to practice better methods.

AMOUNT OF PLANT FOOD REQUIRED BY THE KIND OF CROP GROWN.— It is a well-known fact that different crops need different quantities of nitrogen, potash and phosphoric acid compounds. If we know with a fair degree of accuracy how many pounds of nitrogen, potash and phosphoric acid a crop of any kind will remove from the soil, then we have fairly definite knowledge of the amounts of different forms of plant food to apply to the soil to insure a crop. If we could not depend upon the soil to furnish any plant food, then we should use, at least, the amounts of fertilizing materials removed by one crop.

In the following table, we give the number of pounds of nitrogen, phosphoric acid and potash used by different kinds of crops grown on one acre of land. The yields have been made variable within fairly wide limits so as to cover most cases found in actual experience. The calculations are based upon the most reliable analyses available.

In studying this table, we must keep in mind that the figures do not in every case represent the amount of plant food removed from the soil. Thus, with clovers, beans, peas and other leguminous crops, a portion of the nitrogen is obtained from the air and hence we need to apply less nitrogen in the form of fertilizer than appears to be called for by the table. In the case of fruits, like apples, pears, plums, etc., it will be found safe often to apply larger quantities than the table calls for, because the figures in the table do not indicate the demands made by the tree in increasing growth:

Approximate Amount of Fertilizing Materials Contained in One Crop Grown on One Acre.

Kind of Crop.	Yield of grain, fruit, etc.	Yield of straw, etc.	Pounds of nitrogen.	Pounds of phosphoric acid.	Pounds of potash.
Apples	10 to 20 tons.	———	26 to 52	2 to 4	40 to 80
Barley	20 to 40 bu.	1,350 to 2,700 lbs.	35 to 70	11.5 to 23	34 to 68
Beans	20 to 40 bu.	1,800 to 3,600 lbs.	75 to 150	20 to 40	55 to 110
Buckwheat	15 to 30 bu.	1,200 to 2,400 lbs.	20 to 40	10.5 to 21	17.5 to 35
Cabbage	15 to 30 tons.	———	100 to 200	35 to 70	135 to 270
Clover, crimson (green)	———	7½ to 15 tons.	65 to 130	20 to 40	70 to 140
Clover, red (hay)	———	1 to 2 tons.	41 to 82	10 to 20	40 to 80
Corn	30 to 60 bu.	2,500 to 5,000 lbs.	42 to 84	16 to 32	17 to 34
Grapes	1 to 2 tons.	3,000 to 6,000 lbs.	7 to 14	18 to 36	26 to 52
Hops (whole crop)	1,600 to 3,200 lbs.	———	40 to 80	28 to 56	32 to 64
Mixed hay	———	1 to 2½ tons.	28 to 70	7 to 17.5	31 to 77
Oats	30 to 60 bu.	1,600 to 3,200 lbs.	30 to 60	11 to 22	25 to 50
Onions	350 to 700 bu.	———	35 to 70	10 to 20	30 to 60
Pears	8 to 16 tons.	———	16 to 32	5 to 10	13 to 26
Peas	15 to 30 bu.	1,500 to 3,000 lbs.	50 to 100	16.5 to 33	26 to 52
Plums	4 to 8 tons.	———	15 to 30	2 to 4	20 to 40
Potatoes	100 to 200 bu.	750 to 1,500 lbs.	25 to 50	10 to 20	35 to 70
Rye	15 to 30 bu.	2,100 to 4,200 lbs.	24.5 to 49	13 to 26	21 to 42
Sugar beets	300 to 600 bu.	3,000 to 6,000 lbs.	55 to 110	20 to 40	95 to 190
Timothy hay	———	1 to 2 tons.	25 to 50	10 to 20	30 to 60
Tobacco	800 to 1,600 lbs. leaves.	700 to 1,400 lbs. stems.	38 to 76	8 to 16	100 to 200
Tomatoes	5 to 10 tons.	2 to 4 tons vines.	50 to 100	10 to 20	50 to 100
Turnips	350 to 700 bu.	2½ to 5 tons.	50 to 100	26 to 52	90 to 180
Wheat	15 to 30 bu.	1,600 to 3,200 lbs.	31 to 62	10 to 20	13 to 26

An examination of the foregoing table justifies the assertion, when we consider all the conditions, that the smallest amounts of plant food we can expect to use on an acre of land with any satisfactory results are the following:

Ten pounds of nitrogen.
Fifteen pounds of available phosphoric acid.
Twenty pounds of potash.

To state this in another form, the foregoing amounts of nitrogen would be contained in 200 pounds of a fertilizer having the following composition:

Nitrogen, 5 per cent.
Available phosphoric acid, 7½ per cent.
Potash, 10 per cent.

This would be regarded as a high-grade fertilizer, and on some soils an application of 200 pounds an acre would be considered large, while on others it would be entirely insufficient. The above rule will probably be found fairly safe to follow in fertilizing average crops, when we know nothing at all in regard to soil or crops.

KIND OF FARMING.— The amount of plant food required for the economical growth of plants must depend to some extent upon the specific character and method of farming. In the case of garden truck crops, where it is desired to secure maximum crops at the earliest possible time of season, it is the practice to apply amounts of plant food which would be considered excessive in general farm practice. The farmer who practices an intelligent form of rotation can raise crops with less expenditure for fertilizers than can the one who does not use a desirable form of rotation. The subject of rotation of crops is of such importance in connection with the use of plant food, that we will later consider it in some of its more important applications.

4. IN WHAT FORMS IS IT BEST TO BUY PLANT FOOD?

We have previously seen that we can obtain nitrogen in several different forms, such as nitrate of soda, sulphate of ammonia, dried blood, tankage, fish-scrap, etc. Similarly we find in the market phosphoric acid obtained from several different sources, and we also find several different potash compounds. When we come to use fertilizing materials as a source of plant food, we must decide which specific forms we shall apply. To illustrate, in applying some form of nitrogen, shall we use nitrate of soda, or sulphate of ammonia, or dried blood, or fish-scrap? Shall we use as our source of phosphoric acid bone-meal, dissolved bone, acid phosphate, dissolved bone-black or Thomas slag? Shall we apply muriate of potash, or sulphate of potash, or carbonate of potash What principles are there to guide us in making the best choice?

In deciding what form of material to use for plant food, we should be guided by:

(1) The availability of the plant food;

(2) The preference, if any, shown by different plants; and,

(3) The comparative economy possible in purchasing different materials.

AVAILABILITY OF DIFFERENT FORMS OF PLANT FOOD.— As a rule, commercial fertilizers are used for the purpose of increasing the single season's crop to which they are applied. Most farmers plan to give to each succeeding crop by itself the plant food it needs, and to avoid supplying any one crop with more material than it can use to best advantage. This is especially true of those who do not own the farms which they work and who plan each year's work by itself, without reference to the future. Under such circumstances a farmer desires to use those forms of fertilizing materials which will be taken up most quickly and completely by the crops. On the other hand, the farmer who owns his land, frequently desires to use materials, the plant food of which will be utilized gradually by crops and which will last through several seasons. It will thus be seen that if one desires a fertilizer which will act at once and be largely used up by the present crop, then he will need to purchase his plant food in forms different from those purchased by the man who desires more lasting benefits, extending through several seasons.

We will now consider the relative rapidity with which different forms of nitrogen, phosphoric acid and potash are available for the use of plants.

(a) *Availability of Different Forms of Nitrogen.*

(*1*) *Nitrate of Soda* is easily soluble in water and is utilized as such directly by plants. Therefore, as soon as nitrate of soda dissolves and reaches the root system of plants, it is immediately absorbed and used as plant food. The ease with which it dissolves in water enables it, in the presence of moisture, to distribute itself quickly through the soil and reach the plant roots. Hence, on account of its ease of solution and immediate absorption and utilization by plants, nitrate of soda is the most available form of nitrogen that we can use in feeding plants. Under favorable conditions the effect of applying nitrate of soda to plants may be seen in one or two days.

(2) *Ammonia Compounds* follow nitrate of soda in point of availability as plant food. The most common ammonia compound used is sulphate of ammonia. It is easily soluble in water and has, like nitrate of soda, the advantage of quick distribution in the soil within reach of the plant roots. However, unlike nitrate of soda, it is a form which plants do not absorb and use as such to any marked extent, if at all. Therefore, sulphate of ammonia or any ammonia compound must first be changed in the soil into the form of nitrate compounds before plants can utilize it as food. This change takes place quite rapidly under favorable conditions. Sulphate of ammonia gives better results than nitrate of soda in very wet seasons, because the latter may be washed down into the soil beyond reach of the roots. Another advantage is that the action of nitrogen in the form of sulphate of ammonia is more gradual and prolonged, when such action is desired rather than very quick action.

(3) *Dried Blood* is one of the most quick-acting organic materials used for fertilizers, but is less rapid than sulphate of ammonia or nitrate of soda. Its organic nitrogen passes through a series of changes by which it is transformed into ammonia and finally into nitrate compounds, before being used by plants.

(4) *Fish*, dried and ground fine, is a little slower in its action than dried blood in furnishing nitrogen.

(5) *Tankage* is still slower in action than the preceding forms of animal matter. Its rapidity of action increases with its fineness.

(6) *Bone* furnishes nitrogen with varying degrees of availability. The nitrogen in raw, coarse bone is extremely slow in its action. The removal of fat by steaming or boiling makes the nitrogen of bone more available. The availability of the nitrogen of bone is also closely in proportion to its fineness of division.

(7) *Horn and Hoof Meal* have been shown to possess about the same rapidity of action as finely-ground dried fish.

(*8*) *Leather* varies in its rapidity of action according to its condition. Raw leather is practically valueless as a source of nitrogen for plants. *Roasted* and *steamed* leather has a little more value than raw leather, but is comparatively valueless. However, the nitrogen in finely-ground leather that has been carefully treated with sulphuric acid has a degree of availability about equal to that of ground fish.

(*9*) *Cotton Seed Meal and Castor-Pomace,* finely ground, furnish nitrogen that is utilized by plants in about the same degree as ground fish or even dried blood.

Various experiments have been made to determine the comparative plant-food value of nitrogen in the more common animal and vegetable materials. While the results have not been uniform, they serve as a fair guide. Taking results secured with nitrate-nitrogen as 100, the following table can be made:

TABLE Showing Comparative Plant-Food Value of Nitrogen in Animal and Vegetable Materials.

	Availability or crop producing value.
Nitrate of soda	100
Dried blood	70
Cotton seed meal	70
Castor-pomace	70
Fish, dried and ground	68
Horn and hoof meal	68
Dissolved leather	65
Steamed	15
Roasted leather	10
Raw leather	2

It must be understood that the above figures are only approximate and are not of universal application. They indicate what is fairly true when used on the same crop under the same conditions. To illustrate: If by the application of 50 pounds of nitrate-nitrogen we were able to increase a wheat crop 100 pounds an acre, the application of the same amount of nitrogen in the form of dried blood, cotton seed meal or castor-pomace would increase the crop 70 pounds an acre; the increased yield from use of dried fish, horn and hoof meal would be 68 pounds; from raw leather, two pounds, etc.

(b) *Availability of Different Forms of Phosphoric Acid.*

The availability of phosphate compounds as plant food depends upon several conditions, among which may be mentioned:

(1) The form of compound; (2) the kind of material; (3) the fineness of division; (4) the character soil, and (5) kind of crop.

(1) The Availability of Phosphoric Acid Dependent on Form of Compound.— The water-solubles form of phosphates is readily distributed in the soil and is immediately absorbed and used by roots as plant food. Therefore, water-soluble phosphates present in dissolved rock, superphosphates, dissolved bone, etc., represent the form most quickly available.

The *citrate-soluble or reverted* form of phosphates does not dissolve easily in pure water, but does dissolve fairly well in soil water and in the acid plant juices contained in and exuded by the rootlets. The disadvantage in using reverted phosphate is, that on account of its slow solubility it is not quickly, thoroughly and uniformly distributed through the soil, and consequently does not come so easily into contact with the roots of plants.

The *insoluble* form of phosphates, like ground rock, is not easily available under ordinary conditions.

(2) Availability of Phosphoric Acid Dependent on Kind of Material Furnishing it.— Mineral phosphates untreated are changed into soluble forms very slowly under usual conditions and they become available as plant food much less easily and quickly than do phosphates contained in animal or vegetable matter. In organic matter, as bone, for example, the phosphates are associated intimately with material that decays easily, and, in the process of such decay or rotting, the phosphate compounds are more or less changed and made soluble.

(3) Availability of Phosphate Compounds Affected by Fineness. — It has been found in usual practice that the phosphate compounds, especially of organic matter, are more quickly available as they are more finely ground. Increased fineness increases the rapidity with which the phosphate compounds can be acted upon and rendered soluble by natural agencies.

(4) Availability of Phosphate Compounds affected by Kind of Soil.— Soils containing an abundance of decaying organic matter usually favor the more rapid change of insoluble to soluble phosphates. On muck soils the application of undissolved rock in the form of " floats " gives about as good results as the dissolved phosphate. The insoluble phosphates contained in the soil

may be made gradually available by keeping the soil well supplied with humus, together with occasional liming.

(5) *Availability of Phosphates Influenced by Kind of Crop.*— Different plants have been found to show varying degrees of power to appropriate the same kind of plant food. For example, fine-ground insoluble phosphate rock may be utilized to a greater or less extent by wheat, barley, corn, peas and turnips, while beans and potatoes do not seem benefited. Turnips especially appear to thrive just as satisfactorily on the fine undissolved as on the dissolved rock. When a crop can advantageously use a cheaper form of plant food, it is economy to use that form.

(*c*) *Availability of Different Forms of Potash.*

There is little difference between the different compounds of potash in respect to the readiness with which plants use them as food. Muriate of potash dissolves a little more readily and is distributed through the soil somewhat more quickly than sulphate of potash.

PREFERENCES SHOWN BY PLANTS FOR DIFFERENT FORMS OF FOOD.— It is a fact of great interest and importance, that one form of a fertilizing constituent is preferred by some plants to the same constituent in another form. This preference is indicated by greater yield or better quality of product or by both. The most striking instance is the effect of potash salts upon tobacco crops. The quality of tobacco is injured by potash in the form of muriate, and hence only sulphate should be used for fertilizing purposes. The quality of sugar beets and of potatoes often appears to be better when sulphate of potash is used.

Much investigation in this interesting field remains yet to be made. The facts now known are meager, but so far as known they should be utilized. Whenever a plant shows any marked preference for any special form of food, we should supply that particular form if practicable.

ECONOMY IN PURCHASING DIFFERENT FORMS OF PLANT FOOD. — Other things being equal, we can effect considerable saving in purchasing fertilizing materials by a careful selection based upon a study of market values.

The most expensive form in which nitrogen is usually purchased is that of sulphate of ammonia. When high-grade sulphate of ammonia sells for $60 a ton, each pound of nitrogen in it costs about 15 cents. When high-grade nitrate of soda sells for $40 a ton, each pound of nitrogen in this form costs about 12½ cents. As between these two forms, the nitrogen of one is two and one-half cents a pound cheaper than the nitrogen of the other, and it will, therefore, be found more economical to use nitrate of soda rather than sulphate of ammonia, when special circumstances do not require the use of the latter. Dried blood, containing 13 per cent. of nitrogen, at $36 a ton, furnishes nitrogen at an approximate cost of 14 cents a pound. The nitrogen in fish scrap may cost somewhat less. In such forms as wool waste, ground leather and hair, nitrogen may be purchased at much less, but these forms are not usually economical at any price.

The cheapest possible manner in which farmers can provide their crops with nitrogen is by means of such plants as clover. These plants can supply themselves with nitrogen from the air, and can thus store up nitrogen for future use in the soil. Nitrogen supplied in this way can be made, to a considerable degree, to take the place of the nitrogen of commercial fertilizers, and at a greatly diminished cost. By such means the use of the most expensive of fertilizing materials can be greatly diminished and much saving effected.

Soluble phosphoric acid can in general be more cheaply purchased in the form of dissolved rock than in the form of dissolved bone or bone-black.

Muriate of potash costs less than sulphate, and is, therefore, more economical when its use answers one's purpose. With the exception of a few crops, like tobacco, sugar beets, and potatoes, muriate of potash can nearly always be used to advantage. Potash in the form of carbonate, as found in wood ashes, is apt to be somewhat expensive. When ashes contain five per cent. of potash and two per cent. of phosphoric acid and cost $10 a ton, each pound of potash costs about eight cents, while in the form of muriate of sulphate, the cost would be about one-half. It is easily conceivable, however, that on acid and certain other soils the use of ashes might prove economical. The only way of telling with absolute certainty whether ashes will prove more economical than other forms of potash is to make an actual trial.

In applying fertilizers, bulk is often desirable, but in *purchasing commercial fertilizers, the object should be to secure as much nitrogen, potash and phosphoric acid in available forms as possible for one dollar, instead of as many pounds as possible of fertilizer, regardless of the amount of plant food contained in it.* This is particularly applicable to mixed fertilizers, which at present form the larger proportion of fertilizers sold in this State. Since there is smaller bulk to handle in mixing, a smaller number of packages for holding, and, consequently, less weight and freight, it is, as a rule, more economical to purchase fertilizers in their more concentrated forms. For illustration, it is more economical to purchase one ton of a high-grade fertilizer than three tons of a low-grade fertilizer, one ton of the former containing the same amount of plant food contained in three tons of the latter; because, in making the latter, three times as much labor is involved in mixing the goods, three times as many packages are required and three times as much freight must be paid, all for the same amount of plant food.

5. WHICH IS MORE ADVANTAGEOUS, TO PURCHASE COMPLETE FERTILIZERS OR TO PURCHASE INGREDIENTS?

The question of home mixing of fertilizers is now being much discussed. Not a few farmers have adopted the plan of purchasing unmixed ingredients and mixing them at home. When a farmer once tries this method, he rarely purchases a ready-mixed complete fertilizer after that. It is pertinent in this connection to consider both sides of the question, both the advantages and disadvantages of purchasing unmixed fertilizing ingredients.

ECONOMY.— The average retail price of a ton of mixed fertilizer is from $8 to $9 above the market value of its unmixed ingredients. This difference represents the cost of mixing, freight, profit, etc. It is readily seen that a portion, at least, of the difference can be saved by purchasing unmixed ingredients. Many farmers who have done their own mixing, estimate that the mixing costs them 75 cents a ton on an average. In mixed fertilizers, a pound of nitrogen costs the farmer, on an average, about 20 cents, while he ought to be able to purchase it in the very best forms at a total cost not to exceed 15 cents. Available phosphoric acid and potash in mixed fertilizers cost farmers six to seven cents a pound, and they can usually be purchased unmixed for three and three-fourths to four and one-half cents, total cost.

DEFINITE KNOWLEDGE OF MATERIALS USED.— When separate materials are purchased, the farmer can more closely ascertain whether his goods are what they claim to be. Ground leather cannot be passed for nitrate of soda, sulphate of ammonia, etc. In mixed goods it is not easy to detect inferior articles. The chances are that the farmer will get better materials in unmixed than in mixed goods, although this would not be true in dealing with the most reliable manufacturers.

VARIATION OF MIXTURE TO SUIT DIFFERENT CROPS.— By careful observation and experiment in the manner previously described, the farmer can change his mixture so as to adapt it more nearly to the needs of his crops and soil. Manufacturers claim to manufacture goods which are specifics for different crops. But it is noticed that the special mixtures for the same crop, as made by different manufacturers, vary quite as much as do mixtures for different crops. For illustration, taking forty different potato manures in the market, we find that they vary in nitrogen from 1.50 to 6 per cent.; in available phosphoric acid, from 4.75 to 11 per cent.; and in potash, from 2.50 to 11.50 per cent.; and yet each claims to be exactly adapted to the needs of the potato crop. We have met with instances where the manufacturer used the same formula as a special for different crops whose needs were quite unlike. It is safe to say that, without any experience, the farmer can hit the needs of his soil and crops by mere guess quite as closely as do some of the complete fertilizers. The farmer can ascertain what particular forms and quantities of materials are best suited to his needs by means of simple experiments.

EDUCATIONAL VALUE.— There is little of educational value in using an unknown mixture. To purchase intelligently unmixed fertilizing materials will ultimately lead in most cases to a well-grounded knowledge of the science of agriculture. One will seek to know what the different forms of plant food are, what they do, from what sources they can be obtained, and how he can use them to best advantage. He will become to some extent an investigator, and will, of necessity, take a deeper interest in his work. His entire system of farming will be lifted to a higher plane and his more intelligent labor will yield more profitable results.

The chief disadvantages connected with purchasing separate materials are the following: (1) On small purchases little or no reduction of price is made. This may often be true, but in such cases it is easily possible for farmers to combine and order larger lots. (2) It is claimed that, owing to lack of proper facilities, the farmer cannot make mixtures that will be even and fine. So far as actual results go, it is found that farmers can and do make mixtures which are, on an average, very satisfactory in their practical working as compared with mixtures of manufacturers.

It has been represented to farmers that peculiar virtues are imparted to the elements of plant food by proper mixing, and that this proper mixing can be accomplished only by means not at the command of farmers. Such statements are misrepresentations, based either upon the ignorance of the person who makes them or upon his anxiety to sell mixed goods. Nitrate of soda, for illustration, does its work in plant nutrition in exactly the same manner whether it is added to the soil as part of a mixture or whether the ingredients of the mixture are applied separately. The availability of plant food is not usually affected by mixing. Other conditions determine whether a fertilizer shall be applied in mixed form or in separate materials.

6. TO WHAT EXTENT HOME MIXING IS PRACTICABLE.

The conveniences needed to do one's own mixing are the following: A tight barn floor, or earth floor that is hard, smooth, dry and under cover; platform scales, shovel, iron hand-rake or hoe and a sand screen. Farmers are advised, if they do their own mixing, not to attempt to treat bones or rock with sulphuric acid (oil of vitriol), but to purchase their superphosphate from the manufacturer.

The advantages connected with having the mixing of fertilizers done at a factory are the following: First, the mixing is apt to be more thoroughly done at the factory. Second, the factory should be able to do mixing in large quantities more economically, since it has all facilities required. As a rule, it costs the farmer from $2.50 to $3 to have the mixing and rebagging done at a factory for each ton of materials.

When the farmer prefers to purchase separate materials and do his mixing at home, the following suggestions may be helpful: If one has purchased the different materials in the right weights, such as he wants to use for mixing, then no weighing is necessary, as he has simply to mix all the materials he has. If he makes different mixtures, then the different materials should be weighed accurately. If the material is at all lumpy, it should be sifted with a sand screen, the lumps separated and then pulverized before being added to the pile of fine material. When the materials have been thus prepared, the most bulky material is spread out upon the floor in an oblong pile that varies from 6 to 10 inches in depth. The top is leveled off and then a layer of the next material is put on, not quite so thick, and so on until the different constituents have been added to the pile, care being taken to make such material cover the one under it evenly over the whole surface. Then, one should commence at one end and shovel over the pile, reaching clear to the bottom every time. After mixing well, the mixed portion is passed behind. When the whole pile has been treated once in this way, then the mixed pile is leveled, swept up around the edges and again treated in the same manner. This process should be repeated three or four times. Any lumps noticed at any time should be thoroughly broken up. If greater thoroughness is desired, the mixture may be sifted or screened before sacking. It is convenient to weigh into sacks which will hold from 100 to 150 pounds. One should take great pains to purchase his materials in finely powdered and perfectly dry condition, if he plans to mix the materials at home.

7. SPECIAL SUGGESTIONS RELATING TO THE PURCHASE OF SEPARATE FERTILIZING INGREDIENTS.

In addition to what has been already stated, there are some other suggestions which it is well to heed in connection with the purchase of separate fertilizing materials.

PURCHASE OF HIGH-GRADE MATERIALS.— It will almost invariably be found more economical to purchase high-grade fertilizing materials.

In *applying* fertilizers, bulk is often desirable, but in *purchasing* commercial fertilizers, the object should be to secure as much nitrogen, potash and phosphoric acid in available forms as possible for $1, instead of as many pounds as possible of fertilizer, regardless of the amount of plant food contained in it.

FINENESS AND DRYNESS OF FERTILIZERS IMPORTANT.— Fertilizers cannot, as a rule, be in too finely powdered condition, nor can they be too dry. With many materials, bone for example, the availability as plant food is directly dependent upon the fineness of division. Two commercial fertilizers containing the same amount of plant food in the same forms may differ considerably in respect to the availability of that food and, consequently, in respect to their agricultural value, if one is coarsely and the other finely ground. Excessive moisture in fertilizers is undesirable on several grounds. First, the larger the amount of moisture, the smaller will be the amount of plant food in a ton. Second, excess of moisture causes the particles to stick together and is likely to result in caking and in clogging when used in drills. Third, an excess of moisture favors the decomposition and loss of nitrogen in many forms of organic matter. This is shown by the fact that some fertilizers give off a very offensive odor if allowed to become damp, while they are comparatively free from disagreeable odors if they are thoroughly dry. A strong odor in a fertilizer is an indication that organic matter is decomposing and nitrogen is being lost and indicates weakness and loss rather than strength as a fertilizer.

TAKING ADVANTAGE OF FLUCTUATING PRICES.— By watching the market variations, it is possible to save more or less. It often happens that lower prices prevail during that part of the year when the farmer has most leisure. In any case, where home mixing is practiced, it should be done before the beginning of the busy season. It is well for farmers early in winter to enter into correspondence with three or four different parties to ascertain the prices at which they can purchase the plant food materials they desire.

PURCHASE OF PLANT-FOOD MATERIALS ACCORDING TO "UNIT" SYSTEM AND ACCORDING TO TON SYSTEM.— The more common method employed by farmers in purchasing fertilizers, whether mixed or unmixed, is to pay a given price for a ton of goods without particular reference to the guaranteed composition, that is, the amount of plant food contained in them. In purchasing such high-grade materials as nitrate of soda, sulphate of ammonia, dried blood, potash salts, etc., the composition is fairly uniform and one may usually feel safe in purchasing by the ton. However, in a variable material like tankage, for instance, it is unwise, to purchase by the ton, at least without a guarantee.

The "unit" system is based on actual amounts of plant food contained in the goods purchased. A unit of plant food is 1 per cent. for one ton, that is, twenty pounds. A unit of nitrogen is 20 pounds of nitrogen, a unit of available phosphoric acid is 20 pounds of available phosphoric acid, and a unit of actual potash is 20 pounds of actual potash. In quoting prices a dealer might offer sulphate of potash at $1 per unit of actual potash (20 pounds). That would mean five cents a pound. This is the most satisfactory system of purchasing, for the consumer pays for just the amount of plant food he buys.

MAKING CLUB FERTILIZERS.— In some towns farmers club together and purchase their separate ingredients, each one doing his own mixing himself. In other cases the club decides upon a definite formula and sends out specifications to manufacturers for furnishing the same already mixed and sacked, letting the contract to the lowest responsible bidder. One of the most successful instances of this sort is the Riverhead Town Agricultural Society of Long Island. They have found that a fertilizer containing 4 per cent. of nitrogen, 8 per cent. of available phosphoric acid and 10 per cent. of actual potash is well adapted to their conditions for growing potatoes and vegetables. They require the nitrogen to be distributed in three different forms, one-half being fish scrap; one-fourth, nitrate of soda; and one-fourth, sulphate of ammonia. The potash must be in form of muriate. For the season of 1899 they were able to get 1,000 tons or more of this mixture made at $24.80 a ton. Commercial fertilizers of similar composition sold for $36 to $40 at the same time. The actual saving effected by the members of this club amounts to not less than $10,000 a year. At the above price nitrogen cost them 11.7 cents a pound, available phosphoric acid 3.6 cents a pound and potash as muriate 3.75 cents a pound. It will be noticed that these prices are a little more than one-half those paid for plant food by the average farmer purchasing mixed fertilizers in the ordinary way. The members of this club paid $24.80 for each ton of fertilizer, which would have cost farmers, buying at the average prices paid for plant food in mixed fertilizers, $38.64.

WHERE TO PURCHASE UNMIXED MATERIALS.—Any large manufacturer of fertilizers will generally fill orders for separate ingredients. Farmers are advised to write to three or four different firms and get their prices. In comparing prices, one should take into consideration the question of freight. The schedule of prices given later may be used as a general guide in regard to what one should pay for different forms of materials.

Farmers will find their chief difficulty in knowing in what forms and quantities to order separate fertilizer constituents.

The suggestions found in subsequent pages giving this information in regard to our more common crops will be found helpful.

8. METHODS AND SEASONS OF APPLYING FERTILIZERS.

The method to be used in applying a fertilizer depends primarily upon the efficiency with which the constituents of the fertilizer are distributed most thoroughly and uniformly throughout the portion of soil where the plant roots are. The effect of a fertilizer is lost so far as it does not reach the plant roots. Pains must be taken to secure even and complete distribution of fertilizers on or in the soil, since it is desired to have the food reach every plant in the field. In order to distribute small quantities of concentrated fertilizers over a broad area, it is well to dilute by mixing with some such substance as dry earth, road dust, sifted coal ashes or sand.

DRILLING AND BROADCASTING.—As between applying fertilizers with the drill or by broadcasting, the best results are given sometimes by one and sometimes by the other method, according to the crop and special conditions. Labor is saved by using the drill, while the best ultimate results appear more often to come from broadcasting, ploughing or harrowing in accordance to circumstances. When a fertilizer is especially needed by a crop in its earliest stages, there is advantage in drilling it in with the seed. When concentrated fertilizers are to be distributed broadcast, it is desirable that they should be somewhat diluted to promote uniform distribution. When a concentrated fertilizer is drilled in, great pains must be taken to keep the fertilizer from coming into direct contact with the seed, because many of the commercial fertilizing materials will injure the seed if brought into direct contact. Drilling has the advantage of placing the plant food just where the rootlets of the young plant can use it in the early stages of growth, when they most need it. Where the root system is small and is confined to rows or hills some distance apart, drilling may use less plant food than broadcasting for an equally good crop.

DISTRIBUTION OF SOLUBLE FERTILIZERS.— Materials which are readily soluble can be scattered over the surface. After the first fall of rain they distribute themselves throughout the soil very completely and uniformly. Such materials are nitrate of soda, sulphate of ammonia, soluble phosphates and soluble potash salts. These materials are preferably used in case of top-dressing.

DISTRIBUTION OF FERTILIZERS NOT READILY SOLUBLE.— Materials which are not readily soluble are preferably well mixed through and beneath the soil. Thus, dried blood, bone-meal, fish scrap and similar materials are best placed at greater or less depth beneath the soil, because under these conditions they become soluble more rapidly and are retained more surely by the soil. However, the mistake should not be made of working such materials into the soil too deeply, because their plant food may be lost by leaching and carried down beyond the reach of the roots.

TIME OF APPLICATION.— Fertilizers which dissolve easily and diffuse through the soil rapidly, and which are not readily retained by the soil, are best applied only when the crop is ready to utilize them. If put on too early, there is danger of their being leached from the soil and carried more or less beyond the reach of the plant and thus lost. Nitrates and, to a less extent, ammonia compounds come under this precaution. Hence, it is not wise ordinarily to apply guano, ammonia compounds or nitrate of soda in the fall, except in climates which have a dry fall and winter. Their application should be deferred until spring. In wet springs, ammonia compounds are preferably applied rather than nitrate of soda; or, if nitrate of soda is used, loss may be avoided by making several small applications, instead of one at the start. Care should be taken, however, not to make applications of nitrate of soda too late in the season, as the maturing of the crop will be retarded and there will be an excessive growth of stems and leaves.

Fertilizers which do not dissolve readily or which do not diffuse through the soil rapidly are better applied to the land before the crop commences its growth. To this class belong stable manure, bone-meal, dried blood, tankage, cotton seed meal, ground rock, and to some extent, soluble phosphates and potash compounds.

SPECIAL PRECAUTIONS.— In applying highly concentrated commercial fertilizers, it is wise to prevent the fertilizer coming in contact with the seeds or foliage of plants.

Fertilizers containing ammonia compounds should not be mixed with wood ashes, lime, or Thomas slag (odorless phosphate), since some of the ammonia is likely to be lost.

On soils of loose texture and small retentive power, it is best to use, for the most part, those forms of fertilizers which are not too easily soluble, in order to make as small as possible the losses occasioned by heavy rains. Animal and vegetable materials are especially suited for such cases.

9. THE MOST ADVANTAGEOUS METHODS OF USING FARM-PRODUCED MANURES.

Under this head we will discuss some of the more common points relating to the use of stable manure in its application to different soils and crops.

Amount of Application.— In applying stable manure to soils, it may be kept in mind, as a general guide that a ton of good stable manure approximately contains:

Ten pounds of nitrogen;
Five pounds of phosphoric acid, and
Ten pounds of potash.

From one-half to two-thirds of this plant food should become available during the first season.

When stable manure is applied alone, five tons an acre may be suggested as the smallest amount to use. The exact amount will vary, of course, with the condition of soil and the kind of crop. Ten tons an acre ought to be sufficient for general farm crops. It is more economical to apply smaller amounts at more frequent intervals. The frequent use of light applications of stable manure keeps the soil in a more uniform condition of fertility and the nitrogen is utilized more fully and with less loss. It is not infrequent that farmers apply 20 tons of stable manure to one acre of land. This means 200 pounds of nitrogen, 100 pounds of phosphoric acid and 200 pounds of potash. Very few farm crops can possibly make use of so much plant food in one season.

STABLE MANURE SUPPLEMENTED BY COMMERCIAL FERTILIZERS. — It will probably be found true in most cases that the greatest good can be derived from farm manures by supplementing them by commercial fertilizers. While this is true of most crops, it is particularly true of garden crops where large amounts of plant food are required. To give a roughly approximate idea, we might say that for every ton of stable manure applied it would be well to use with it from 50 to 100 pounds of acid phosphate and from 25 to 50 pounds of high-grade muriate or sulphate of potash. This is best accomplished in the manner described on page 245.

USE OF FRESH MANURE.— The statements below apply to fresh manure containing only small amounts of coarse litter. It appears to be the prevailing belief, both in the theory and practice, that best results are ordinarily secured by applying stable manure to the soil in as fresh condition as possible. Mixed with the soil, fresh manure decomposes readily, having its own constituents made more available as plant food, and, moreover, rendering available some of the insoluble plant food previously in the soil. In this way losses from destructive forms of fermentation, leaching, etc., are mainly prevented.

Fresh manure gives better results than rotted manure on heavy clay soils, when one desires to lighten the condition of the soil. However, when one desires direct fertilizing action promptly, fresh manure gives sufficiently quick returns on light soils, becoming available as fast as the plant needs it, if the season is not too dry. On heavy clay soils, manure decomposes slowly and the constituents of fresh manure may not become available as fast as needed. On this account, it may happen that on heavy soils little benefit is seen from the application of fresh manure until the second season after its application.

In dry, hot seasons an excessive application of fresh stable manure tends to "burn out" the soil, this tendency being more noticeable in light than in heavy soils.

Fresh manure used alone and in large quantities has a tendency to favor rapid growth of foliage and stems at the expense of fruit and grain. It is, therefore, more suitable for grasses, forage plants and leafy crops than for grains, when used exclusively and liberally.

Such crops as potatoes, sugar beets and tobacco appear to be injured in quality by the direct application of stable manure. However, on some soils, usually heavy ones, it can be used satisfactorily in growing sugar beets. It is advised in such cases to apply the manure in the fall previous to the spring in which the crops are to be put in, thus allowing time for a considerable amount of decomposition; or it may be applied to corn, following this with the crop liable to be injured by direct application.

When fresh stable manure contains much coarse, undecomposed litter, it is better not to apply it until the coarse portion has become more or less decomposed.

USE OF ROTTED MANURE.— In half-rotted manure, the fertilizing constituents, as a whole, are in readily available form for the use of plants. Such manure is less bulky and more easily distributed than fresh manure. For the improvement of the mechanical condition of a soil, the best results come from using rotted manure on light soils. It must, however, be remembered that on such soils there is more or less danger that some portion of the valuable fertilizing constituents may be leached out and lost. On this account it is found advisable to apply such manure to light soils only a short time before it is needed by the crop. In general, rotted manure is better adapted to spring applications. It is better to apply rotted manure on light soils at frequent intervals in small amounts.

In warm, moist climates, it makes much less difference whether the manure is applied in fresh or rotted condition. In cold climates, however, the use of decomposed manure is preferable.

METHODS OF APPLICATION.— Three methods of applying manure on the field are in common practice. We will briefly consider each of these;

(*a*) *Applying in Heaps.*

By this method the manure is distributed in heaps over the field and permitted to lie some time before being spread. This method is objectionable for several reasons. The labor of handling is increased; there is danger of loss from decomposition and leaching; the manure is not uniformly distributed, the spots beneath the heaps being more thoroughly manured on account of the leaching. Storing manure in very large heaps is less objectionable, provided the heap is carefully covered with earth and not allowed to lie too long.

(*b*) *Applying Broadcast.*

By this method the manure is spread more or less completely and evenly on the field, being plowed in at once or allowed to lie some time on the surface. This is preferably practiced on the level field, where there is little danger from surface washing. In late fall and early spring there is likely to be very little loss of nitrogen. On a loose soil there may be loss from leaching, if the manure is spread long before the crop is put into the soil; but in average experience, this is not apt to be considerable. This method has the advantage of uniform distribution, as the liquid portion is evenly by degrees mixed with the soil. When the manure is leached of its soluble nitrogen compounds it does not decompose so readily. On this account it is well, in case of light or porous soils, to plow the manure in as soon as spread.

In regard to the depth at which manure should be plowed in, it is safe to say that in very compact soils the depth should not be greater than four inches, while in lighter soils the depth may be increased. It is important that the manure be near enough the surface to allow access of sufficient moisture and air, in order that decomposition may not be too much delayed.

It will probably be found most economical for the average farmer to draw the manure as produced directly to the field, and spread it, instead of letting it pile up about the barns or in the barnyard.

(*c*) *Applying in Row.*

This method has the advantage of placing the manure where it will reach the plant most quickly and of enabling one to use smaller amounts than in broadcasting. It is especially applicable for forcing some garden crops. Rotted manure gives good results when used this way.

10. THE USE OF GREEN MANURES.

DEFINITION.— The term "green manures," properly used, means any crop grown chiefly with the object of improving the soil, and not for securing the harvested product.

LEGUMINOUS CROPS OR "NITROGEN GATHERERS" AS GREEN MANURES.— Those plants belonging to the legume or clover family have the power to secure a large part of their nitrogen from the air. When these are turned under the soil as green manures, they add nitrogen to the soil. The nitrogen brought into the soil in this manner is in a form that tends to decompose rapidly and thus furnish plant food for other crops. It must be kept clearly in mind that these nitrogen-gathering crops cannot be successfully grown unless the soil contains an abundance of phosphoric acid, potash and lime. The crop absorbs only such mineral plant food as it finds in the soil and it is a serious mistake to suppose that any green crop adds anything to the mineral plant food of the soil. It may make more available for other crops the phosphoric acid and potash compounds already existing in the soil. Therefore, in growing green crops there should generally be liberal applications of phosphoric acid and potash and often also of lime.

The crops that have been found most efficient as nitrogen-gathering green manures are red clover, crimson clover, cow peas, and soja beans. The clovers tend to improve the physical condition of the soil also, sending down their roots to considerable depths. They are able also to get considerable food from the subsoil. These are marked advantages in their favor in addition to their power to get nitrogen from the air.

The amount of nitrogen these crops draw from the air depends upon the amount of nitrogenous and other plant food in the soil.

The richer the soil is in nitrogen, the less the crop takes from the atmosphere. In order, therefore, to utilize leguminous crops to best advantage as nitrogen gatherers, the soil should contain only small amounts of available nitrogen, but generous amounts of mineral plant food. Under favorable conditions a clover crop will take from the air an amount of nitrogen equal to 50 pounds or more per acre. It is possible by continuous growth of leguminous crops to accumulate an excess of nitrogen in the soil, unless there is added an abundant supply of mineral plant food.

With judicious management in growing clover or some other leguminous crop for use as green manure, it is easily possible to supply the nitrogen for one's crops without purchasing this, the most costly plant-food element.

"NITROGEN-CONSUMING" CROPS AS GREEN MANURES.—Crops other than leguminous plants are used as green manures, the more common ones being rye and buckwheat. These crops do not possess the power of using atmospheric nitrogen. All the nitrogen they use comes directly from the soil. They do not, therefore, add any nitrogen to the soil, but rather they take available nitrogen from the soil and change it to less available forms. Such crops do not increase the fertility of the soil and cannot be used as a substitute for leguminous crops or commercial forms of plant food. The principle advantages coming from the use of these crops as green manures are two: First, they furnish an abundance of vegetable matter that becomes useful in supplying humus-making material; second, they serve as cover crops, thus preventing loss of plant food by leaching. In order to grow these crops well, one must make sure that they have an abundance of plant food of all kinds.

11. ROTATION OF CROPS.

GENERAL PRINCIPLES UNDERLYING ROTATION OF CROPS.—The general object of systematically growing different crops successively on the same soil is to utilize the plant food in the soil most economically, and maintain the soil in condition for raising maximum crops. The system of rotation to be followed must depend upon the kind of soil and character of farming. A fruit grower and a dairyman would follow different systems of rotation. Continuous growth of one crop on the same field is most exhaustive of plant food, as a rule, and, in addition, the physical conditions of the soil deteriorate.

In working by a system of crop rotation, certain general facts should be kept in mind and carried into practice, principal among which are the following:

(*a*) *Use of Remains of Preceding Crop.*— The system of rotation should be such as to utilize to the best advantage any plant-food material furnished the soil by the preceding crop. Thus, after a crop of clover, it is better to grow wheat and then oats rather than the reverse, because the wheat has less power than oats to utilize plant food. If oats were grown first, wheat might be at a disadvantage unless additional plant food were furnished. In general weak-feeding crops, unless specially fed, should precede strong-feeding crops in rotation, so that the former may have the first chance at the more available forms of plant food.

(*b*) *Keeping Soil in Good Mechanical Condition.*— Each class of crops exercises a specific action upon the mechanical condition of soils. Grass crops tend to make a soil compact; grain and hoed crops tend to make the soil open and porous. It is desirable that these conditions should be gradually alternated somewhat. The amount and frequency of loosening and compacting must depend upon the character of the soil. Sandy soils need more of those crops that compact, while heavy clay soils need those crops that will keep it more open. Rotation of crops should have reference to these conditions and aim at the best mechanical condition.

(*c*) *Alternation of Deep-Rooted and Shallow-Rooted Crops.*— By including in a system of rotation crops that have both deep and shallow root systems, the plant food is not taken entirely from the surface soil but more or less from the subsoil. By such treatment the soil is exhausted less quickly and requires less frequent applications of plant food. Then, again, in many soils the potash and lime are largely in the subsoil, the phosphoric acid and nitrogen being mainly in the surface soil. The growing of deep-rooted crops also exercises a beneficial effect upon the mechanical condition of the soil.

(*d*) *Alternation of Nitrogen-Gathering and Nitrogen-Consuming Crops.*— The value of nitrogen-gathering crops as green manures has been already considered. In a four or five-year rotation system, the use of a leguminous crop like clover will, with one good application of stable manure, maintain the soil nitrogen undiminished. In all systems of rotation some nitrogen-gathering crop should be included as an absolute essential.

(*e*) *Rotation of Crops to Maintain Humus.*— The humus of the soil is gradually used up, when hoed and grain crops are continuously grown and this loss of humus may seriously change the physical and plant-food conditions of the soil. The supply of humus may be kept up by use of stable manure and green crops, and this fact should be kept in mind in every system of rotation.

(*f*) *Use of Farm and Commercial Manures in Rotation.*— It is safe to say that economical results will attend the application of farm manures to the land once at least in a rotation of four or five years. Most of the nitrogen needed in addition can be supplied by clover. The balance of feeding will come mostly in the line of phosphoric acid and potash. When commercial fertilizers are used, they will be most beneficial applied to those crops known as weak-feeding.

12. THE USE OF LIME ON SOILS.

Carbonate of lime, slaked lime and quicklime perform four definite functions when applied to soils: (1st) They furnish lime as plant food when it is lacking; (2d) they render available the insoluble forms of nitrogen and potash in the soil; (3d) they lighten heavy soils and compact light soils; and (4th) they neutralize the acidity of sour lands. One disadvantage in using quicklime or slaked lime on soils to be used in growing potatoes is that scabby potatoes are likely to be produced.

HOW TO ASCERTAIN A SOIL'S NEED OF LIME.— Put in a cup a tablespoonful or more of soil and moisten with water enough to make a thick paste. After letting it stand 10 or 15 minutes, insert into the soil a piece of blue litmus paper, of any convenient size, say, two inches long and half an inch wide, inserting about half of it into the soil. Litmus paper can be purchased at any drug store. Allow the litmus paper to remain in the soil two minutes or longer. Then take the litmus paper from the soil carefully without tearing, rinse off the soil with water, and observe whether it is still blue or has become clearly red. If the paper has become clearly red, the soil is acid and the application of lime will be likely to benefit many crops. Be careful not to handle with the fingers the end of the litmus paper that goes under the soil, previous to making the test.

This test may be supplemented by an actual field trial, using beets for a crop, carrying the work out as directed on page 255.

HOW MUCH LIME TO APPLY AND HOW OFTEN.— The general rule may safely be followed of applying lime in smaller quantities at more frequent intervals than large quantities once in several years. In the case of light and dry soils, the range of application would be from 15 to 30 bushels of quicklime per acre, according to the conditions of need. On heavy clay soils and on rich soils, the application may vary from 25 to 75 bushels.

In rotations of five or six years, one liming will probably suffice for the rotation under ordinary conditions. On meadows kept in grass for many years and fertilized exclusively by commercial fertilizers, liming on the surface once in five years may be helpful.

WHEN TO APPLY LIME.— Autumn is the best time to apply lime on land used for spring crops. It must be kept in mind that quicklime is injurious to many crops, but its power to injure plants is gradually lost by lying in the soil. In case of autumn seeding, the lime can be scattered after plowing and then harrowed in very thoroughly. For many crops, lime may be applied in the spring with little risk, provided it is worked into the soil very completely. In case of very sour soils, the application of lime in the spring is often very beneficial.

WHAT FORM OF LIME AND USE.— Of the various forms of lime, it will probably be found that quicklime will prove cheapest, as it is the most concentrated form. This is especially true when the material has to be freighted and drawn some distance.

HOW TO APPLY LIME TO THE SOIL.— Owing to the large lumps usually contained in quicklime, it is not best to attempt to spread it directly upon the soil as this method would not enable one to secure a uniform distribution. The following method will insure more even distribution. The freshly burned lime is placed in heaps 20 feet apart, the amount in each pile depending on the rate of application. Twenty-pound heaps would make about one ton an acre. The heaps are well covered with soil. If the earth is moist, the lime will absorb moisture enough to fall into a fine powder in a few days at most. In case the soil is very dry, throw half a pailful of water or less over each heap before covering it with earth. As soon as the lime has become slaked, it should be spread from the heaps as evenly as possible and then plowed under or preferably harrowed in at once, because the lime is liable to cake with the soil and not yield the best results.

13. PLANT-FOOD MIXTURES FOR DIFFERENT CROPS.

We will now consider in a more specific manner the quantities of different forms of plant food that can be applied to advantage to one acre of land for different crops.

We must make it clearly understood at the start that no rigidly fixed formulas can be given for any crop on all soils. The question of quantity of application and of proportion must always, in the very nature of the case, remain more or less a matter of individual experiment. Every field is constantly changing in the extent and character of its needs. The farmer must constantly study results and let the experience of one year suggest to him his plan for the year following. With this preliminary precaution, it may be of interest to consider briefly what has ordinarily been the method of procedure in determining the proportions of nitrogen, phosphoric acid and potash in making fertilizers for different crops.

In making formulas, it was first proposed to make the formula correspond to the analysis of the plant. This method was practiced for some time, when it was found that there was already in the soil more or less available plant food and that fertilizing material was often applied where one or more constituents could be omitted or reduced in quantity. It was then suggested that soil analysis should form the basis of determining the needs of the soil in different crops, but this failed to produce satisfactory results. The formulas at present used by many have been based, in part, upon the composition of the plant and, in part, upon the actual field-tests.

The amount of nitrogen called for by analysis of plants is generally reduced because we can depend upon the soil to furnish a considerable amount. In case of leguminous crops, the amount of nitrogen which we need to supply can be reduced to a small fraction of what the plant will use, because such crops can draw their main supply of nitrogen from the air.

The amount of soluble phosphoric acid is ordinarily increased above what plant analysis calls for, because the solubility is more or less decreased after the fertilizer comes into contact with the soil.

The formulas given in the pages following have been drawn from such various sources as could be considered reliable.

It will be noticed that, in giving the amount of fertilizer material to put on one acre of land, a variable rather than a fixed amount is given. To illustrate: Instead of prescribing 100 pounds of nitrate of soda for a certain crop, we give the amount as " 100 to 200 pounds." This means that, if the land is in good condition, 100 pounds may answer, but if in poor condition, more should be used up to 200 pounds. Thus, it will be seen that even with the most specific directions that can be given, much must be left to the individual for experiment.

The materials which are given for use in the following pages are assumed to have a fairly definite composition and our calculations are based on the following conditions of composition:

(1) Nitrate of soda, 95 to 96 per cent. pure, containing 16 per cent. of nitrogen.

(2) Dried blood, containing 10 per cent. of nitrogen.

(3) Sulphate of ammonia, containing 20 per cent. of nitrogen.

(4) Stable manure, containing .5 per cent. of nitrogen, one-half available at once.

(5) Cotton seed meal, containing 7 per cent. of nitrogen.

(6) Bone-meal, containing 20 per cent. of total phosphoric acid, one-half being calculated as available during first season of application; also containing 4 per cent. of nitrogen.

(7) Dissolved bone, containing 15 per cent. of available phosphoric acid and 3 per cent. of nitrogen.

(8) Dissolved bone-black, containing 15 per cent. of available phosphoric acid.

(9) Dissolved rock, containing 15 per cent. of available phosphoric acid.

(10) Muriate of potash, 80 per cent. pure, containing 50 per cent. of potash.

(11) Sulphate of potash, 90 to 95 per cent. pure, containing 50 per cent. of potash.

(12) Kainit, containing 12 to 13 per cent. of potash.

(13) Wood ashes, containing 5 per cent. of potash.

To make the foregoing statements in different form, we can say, approximately:

One pound of Nitrogen is furnished by
Five pounds of sulphate of ammonia, or
Six and one-fourth pounds of nitrate of soda, or
Ten pounds of dried blood, or
Fourteen pounds of cotton seed meal, or
Twenty-five pounds of high-grade bone-meal, or
Two hundred pounds of good stable manure.

One pound of Phosphoric Acid is furnished by
Five pounds of bone-meal, or
Six and three-fourth pounds of dissolved bone-black, dissolved bone, or dissolved rock.

One pound of Actual Water-soluble Potash is furnished by
Two pounds of sulphate of potash, or
Two pounds of muriate of potash, or
Eight pounds of kainit, or
Twenty pounds of unleached wood ashes.

It should be understood that the materials given in the following mixtures may not furnish the elements of plant food in the cheapest form. The point of cost must be determined by each individual farmer for himself at the time he makes his purchases.

Alfalfa.

	Per cent.	Pounds for one acre.	Pounds of different materials for one acre.
Nitrogen	1	5 to 10	30 to 60 pounds nitrate of soda; 1 to 2 tons half-rotted stable manure.
Available phosphoric acid	8	30 to 60	200 to 400 pounds dissolved rock.
Potash	10	50 to 100	100 to 200 pounds muriate of potash.

Suggestions.— The quantity given above is intended as an annual surface application after the crop has been started. It may be well to lime the ground thoroughly the fall before putting in the crop. The soil should have an abundance of plant food when the crop is put in, and it is recommended at this time to make the following application: Sixty pounds nitrate of soda, 100 pounds of dried blood (or 150 pounds of cotton seed meal), 500 pounds of dissolved rock, and 400 pounds of muriate of potash. The soil needs to be in the best condition of tillage when putting in a crop of alfalfa and this may be readily secured by previous growth of some crop that requires considerable cultivation. In such case, a part of the fertilizer can be applied to the preceding crop.

Apples.

	Per cent.	Pounds for one acre.	Pounds of different materials for one acre.	Pounds of different materials for one tree.
Nitrogen	2	8 to 16	25 to 50 pounds nitrate of soda; 40 to 80 pounds dried blood.	½ to 1 pound nitrate of soda; ¾ to 1½ pounds dried blood.
Available phosphoric acid	8	30 to 60	200 to 400 pounds dissolved rock.	4 to 8 pounds dissolved rock.
Potash	12	50 to 100	100 to 200 pounds muriate of potash, or 1,000 to 2,000 pounds wood ashes.	2 to 4 pounds muriate of potash, or 20 to 40 pounds wood ashes.

Suggestions.— The growing of apples and similar fruits is a case of continuous cropping of the same character on the same soil and is thereby attended with greater exhaustion of plant food than where rotations can be practical. The amount of plant food to be applied and the age when such feeding should begin must depend upon the soil. On soils naturally good, feeding the trees should begin as soon as the trees commence bearing. On poor soils the largest quantities given above should accompany the setting of the trees, and then the smaller quantities be added every year. On poor and light soils, green manuring can be carried on advantageously for a while. Whenever green manuring is used, the crop should be turned under early in the spring. On soils in good condition, green manuring should not be practiced too continuously. Overfeeding fruit trees with nitrogen must be carefully avoided, as this tends to produce excessive growth of wood, too succulent in character to be hardy, and it also seriously interferes with fruit production.

As the roots of the tree feed through a long-growing season, those forms of plant food can often be used which become available gradually. In place of the mixture given above, one can use the following:

One hundred pounds cotton seed meal.
One hundred pounds fine bone-meal.
One hundred pounds dissolved rock.
One hundred pounds muriate of potash.

In applying plant food annually to fruit trees, it should be put on early in the spring and plowed in. It should be remembered that the feeding roots are situated in the lower layers of the soil, and the plant food should, therefore, be placed as near the roots as practicable, especially with young trees. If plant food that is not easily soluble is placed entirely on the surface of the soil, there will be a tendency on the part of the feeding roots to grow near the surface, and under such conditions, the trees will more easily suffer from drouth. In case easily soluble forms of plant food are used, surface application will give good results.

With increasing age and larger yields of fruit, the amount of plant food applied may be increased to advantage.

Asparagus.

	Per cent.	Pounds for one acre.	Pounds of different materials for one acre.
Nitrogen................	4	20 to 40	60 to 120 pounds nitrate of soda; 50 to 100 pounds dried blood; 75 to 150 pounds cotton-seed meal.
Available phosphoric acid..	8	40 to 80	200 to 400 pounds bone meal; 150 to 300 pounds dissolved rock.
Potash..................	10	50 to 100	100 to 200 pounds muriate of potash.

Suggestions.— In fertilizing asparagus, three facts are to be kept in mind. First, the yield and market value of the crop depend upon the number and size of the shoots; second, the size of the shoots depend upon a large and vigorous growth of tops later in the season, by which nutritive materials are stored up in the roots for the use of the succeeding crop; and, third, the successful growth of the asparagus depends, in large measure, upon proper feeding. Moreover, the length of life of an asparagus bed depends greatly on its feeding.

The asparagus crop grows during the entire season and hence is able to use, to some extent, some of the slower acting forms of plant food. It is essential that a part of the plant food shall be present in quick-acting forms, so that it may be used at once in promoting growth of shoots at the time, and the residue in less soluble forms will continue to feed the crop during the rest of the growing season, thus enabling the plant to store up available nutrition in the roots for use of the crop the year following.

In setting asparagus roots, the soil should be carefully prepared and heavily fertilized. The largest quantities given above and even more will be found desirable. A generous application of half-rotted stable manure supplemented by phosphates and potash is good at this time. Stable manure may also be applied every two or three years in the fall, in addition to the plant-food formula given above.

After the first year the amounts of plant food prescribed should be liberally applied fairly early in the spring. After one begins to cut shoots, it may be well, in addition to this early application, to use at the close of the cutting season, 100 pounds of nitrate of soda, 200 pounds dissolved rock and 100 pounds of muriate of potash, or 400 pounds of kainit in place of muriate. The exact amounts to use must be governed by individual experience.

Barley.

	Per cent.	Pounds for one acre.	Pounds of different materials for one acre.
Nitrogen.................	4	12 to 24	25 to 50 pounds nitrate of soda; 20 to 40 pounds sulphate of ammonia; 40 to 80 pounds dried blood.
Available phosphoric acid..	7	20 to 40	150 to 300 pounds dissolved rock.
Potash..................	8	25 to 50	50 to 100 pounds muriate of potash.

Suggestions.— Barley is a strong-feeding crop and can utilize forms of food not easily available for wheat. Excessive application of nitrogen compounds is to be avoided, when barley is grown for grain. Large applications of stable manure should not be applied directly to the crop on this account, but may be used safely on the crop preceding barley in a rotation.

When barley is grown with peas as a forage crop, much larger amounts of quickly-available nitrogen can be used with advantage.

Beans.

	Per cent.	Pounds for one acre.	Pounds of different materials for one acre.
Nitrogen.................	1	5 to 10	25 to 50 pounds dried blood; 35 to 70 pounds cotton seed meal.
Available phosphoric acid..	7	30 to 60	200 to 400 pounds dissolved rock.
Potash..................	9	35 to 70	70 to 140 pounds muriate of potash.

Suggestions.— The formula given above applies to beans grown for the seeds. When beans are grown to be eaten green, as for string beans, more nitrogen should be applied, as this tends to develop foliage and tender pods and retard ripening. For such purpose the following mixture may be used: One hundred pounds nitrate of soda, 100 pounds dried blood, 150 pounds cotton seed meal or fine ground fish scrap, 500 pounds dissolved rock and 175 pounds of muriate of potash.

Beets.

	Per cent.	Pounds for one acre.	Pounds of different materials for one acre.
Nitrogen	4	20 to 40	125 to 250 pounds nitrate of soda.
Available phosphoric acid	8	25 to 50	175 to 350 pounds dissolved rock.
Potash	10	50 to 100	100 to 200 pounds muriate of potash.

Suggestions.— This application is intended to apply to beets grown for early market for table purposes. The mixture given above may be used at time of seeding, and this followed by applications of nitrate of soda as a top dressing once in 10 days at the rate of 50 pounds an acre for three or four weeks after the plants are well started. This insures rapid and constant growth, under favorable weather conditions, and enables one to secure the higher prices of the earliest product.

In growing *sugar beets,* the aim is to secure the largest amount of sugar possible, and this can be greatly influenced by the kind of plant food given. The following mixture can be used for one acre: One hundred and twenty-five pounds nitrate of soda, 100 pounds sulphate of ammonia, 400 pounds dissolved rock and 150 pounds sulphate or muriate of potash. For best results it is well to apply only about one-third of this mixture before sowing, then another third after the plants are well up and the remainder before the first or second cultivation. Excess of nitrogen tends to produce rapid growth, with large roots and small proportions of sugar of low purity. The foliage should have an early and rapid growth, because the leaves are essential to the formation of sugar. It is not desirable to use slow-acting forms of plant food and thus prolong the growth after the plant should give itself largely to sugar production.

For *fodder* purposes, the aim is to grow as large a crop as possible. Hence, in growing beets for fodder, the plant food should be so planned as to secure a continuous and prolonged growth, rather than early and rapid growth. The following mixture may be used for one acre: Sixty pounds nitrate of soda, 200 pounds dried blood, 150 pounds fish scrap or cotton seed meal, 400 pounds acid phosphate and 180 pounds muriate of potash.

Blackberries.

	Per cent.	Pounds for one acre.	Pounds of different materials for one acre.
Nitrogen	3	15 to 30	25 to 50 pounds nitrate of soda; 50 to 100 pounds dried blood; 100 to 200 pounds cotton seed meal.
Available phosphoric acid	6	30 to 60	200 to 400 pounds dissolved rock.
Potash	8	40 to 80	80 to 160 pounds sulphate of potash.

Suggestions.— An abundance of potash and phosphoric acid is desirable in order to secure a strong and plentiful growth of cane. Moderate acting forms of nitrogen are preferable for the most part.

Buckwheat.

	Per cent.	Pounds for one acre.	Pounds of different materials for one acre.
Nitrogen	2	10 to 20	60 to 120 pounds nitrate of soda.
Available phosphoric acid	6	30 to 60	200 to 400 pounds dissolved rock.
Potash	5	25 to 50	50 to 100 pounds muriate of potash.

Suggestions.— Buckwheat can supply itself from forms of plant food not readily available. It is often grown on the poorer soils of a farm on this account. Frequently phosphoric acid alone gives marked results. Large application of nitrogen must be avoided, as this produces a large growth of straw, with little grain.

Cabbage.

	Per cent.	Pounds for one acre.	Pounds of different materials for one acre.
Nitrogen	4	40 to 80	60 to 120 pounds nitrate of soda; 200 to 400 pounds dried blood; 150 to 300 pounds cotton seed meal or ground fish.
Available phosphoric acid	8	80 to 160	500 to 1,000 pounds dissolved rock.
Potash	10	100 to 200	200 to 400 pounds muriate of potash.

Suggestions.— The cabbage crop is one of the heaviest feeding crops. In addition to the amount of plant food stated above, it will often be found most advantageous to apply a top dressing of 100 pounds of nitrate of soda and 200 pounds dissolved rock per acre after the plants have been transplanted and well started in growth. Later, when the heads begin to form, another 100 pounds or more of nitrate of soda per acre may be applied as a top dressing.

Carrots.

Same as for beets grown for fodder purposes.

Cauliflower.

Same as for cabbage.

Celery.

	Per cent.	Pounds for one acre.	Pounds of different materials for one acre.
Nitrogen.................	4	40 to 80	125 to 250 pounds nitrate of soda; 100 to 200 pounds dried blood; 150 to 300 pounds cotton seed meal or ground fish.
Available phosphoric acid...	8	80 to 160	500 to 1,000 pounds dissolved rock.
Potash...................	10	100 to 200	200 to 400 pounds muriate of potash.

Suggestions.—The above mixture should be used when the plants are set. This may be followed at intervals with a top dressing of 100 pounds of nitrate of soda per acre. On muck soils rich in available nitrogen, special feeding of nitrogen is not equally important. Abundance of water is a great essential for celery in addition to other forms of plant food. Abundance of soluble nitrogen, other conditions being favorable, promotes rapidity of growth, which is attended by the high market qualities of crispness and sweetness.

Cherries.

	Per cent.	Pounds for one acre.	Pounds of different materials for one acre.
Nitrogen.................	2	10 to 20	25 to 50 pounds nitrate of soda; 60 to 80 pounds dried blood.
Available phosphoric acid..	7	35 to 70	250 to 500 pounds dissolved rick.
Potash...................	9	45 to 90	90 to 180 pounds muriate of potash.

Suggestions.— It is desirable that in addition to the amounts of plant food given, an abundance of lime shall be kept in soil where cherries are grown.

Clover.

Same as for alfalfa.

Corn.

	Per cent.	Pounds for one acre.	Pounds of different materials for one acre.
Nitrogen	2	10 to 20	50 to 100 pounds dried blood; 75 to 150 pounds cotton seed meal or ground fish.
Available phosphoric acid	7	35 to 70	250 to 500 pounds dissolved rock.
Potash	6	30 to 60	60 to 120 pounds muriate of potash.

Suggestions.— Corn is a vigorous feeder. It can follow a clover crop with advantage. It is not injured, like many grain crops, by heavy applications of stable manure; but, when fertilized by stable manure, phosphoric acid should be applied also. Corn usually leaves soils in good physical condition for following crops. Phosphoric acid appears in practice to be of special value in growing corn.

The application given above is intended for corn grown as a field crop for the grain. When corn is grown as a *forage* crop, double the amount of nitrogen given above may be used. When corn is grown for *silage,* the following mixture may be applied: One hundred and fifty pounds of dried blood, 200 pounds of cotton seed meal or ground fish, 350 pounds of dissolved rock and 100 pounds of muriate of potash.

For *sweet corn,* a different object is sought. A green and succulent crop, in place of a matured one, is desired, and earliness is usually a special object. The following mixture is suggested for sweet corn: Seventy-five pounds nitrate of soda, 100 pounds of dried blood, 100 pounds of cotton seed meal, 400 pounds of dissolved rock and 150 pounds of muriate of potash.

Cucumbers.

	Per cent.	Pounds for one acre.	Pounds of different materials for one acre.
Nitrogen	4	30 to 60	50 to 100 pounds nitrate of soda; 125 to 250 pounds dried blood; 125 to 250 pounds cotton seed meal or ground fish.
Available phosphoric acid	6	50 to 100	350 to 700 pounds dissolved rock.
Potash	8	75 to 150	150 to 300 pounds muriate of potash.

Suggestions.— This crop thrives best when humus is very abundant in the soil. Too much nitrogen is to be avoided, as there will be a tendency to excessive growth of vines and the fruit will also be large but of poor quality. However, in growing cucumbers for pickles, it may be desirable to use nitrogen and to use most of it in the quickly-acting form of nitrate as this will tend to cause a more abundant setting of fruit and a more rapid growth.

Currants.

	Per cent.	Pounds for one acre.	Pounds of different materials for one acre.
Nitrogen.................	2	10 to 20	50 to 100 pounds dried blood; 75 to 150 pounds cotton seed meal or ground fish.
Available phosphoric acid..	5	25 to 50	175 to 350 pounds dissolved rock.
Potash..................	8	40 to 80	80 to 160 pounds muriate of potash.

Suggestions.— Regular feeding and cultivating adds very much to the yield of this crop. Excess of nitrogen in soils appears to render plants more easily subject to mildew.

Egg Plant.

	Per cent.	Pounds for one acre.	Pounds of different materials for one acre.
Nitrogen.................	4	40 to 80	100 to 200 pounds nitrate of soda; 125 to 250 pounds dried blood; 175 to 350 pounds cotton seed meal or ground fish.
Available phosphoric acid..	5	50 to 100	350 to 700 pounds dissolved rock.
Potash..................	9	90 to 180	180 to 360 pounds muriate of potash.

Flax.

	Per cent.	Pounds for one acre.	Pounds of different materials for one acre.
Nitrogen.................	3	10 to 20	25 to 50 pounds nitrate of soda; 50 to 100 pounds dried blood.
Available phosphoric acid..	8	25 to 50	175 to 350 pounds dissolved rock.
Potash..................	9	30 to 60	60 to 120 pounds muriate of potash.

Suggestions.—Flax requires its food to be in easily available forms and the soil must, therefore, be in good condition. Flax should be grown on the same land only once in four or five years, as the decay of the roots in the soil appears to form products injurious to the flax crop following. Stable manure, when used, should be applied to the preceding crop.

Flowers and Flowering House Plants.

	Per cent.	Pounds for one acre.	Pounds of different materials for one acre.
Nitrogen	5	20 to 40	50 to 100 pounds nitrate of soda; 25 to 50 pounds sulphate of ammonia; 100 to 200 pounds cotton seed meal.
Available phosphoric acid	7	30 to 60	200 to 400 pounds dissolved rock.
Potash	5	20 to 40	40 to 80 pounds muriate of potash.

Suggestions.— This mixture may be used for all kinds of flowering plants grown out of doors. Where flowering plants are grown out of doors only on a small scale, the above mixture can be applied at the rate of one ounce for three or four square feet. It would be well to apply one-third before planting or setting, working the fertilizer lightly into the surface soil; then another third after the plants are well up, and then the rest three or four weeks later. For flowering plants grown in a green house, the same mixture can be used; or, if desired, the phosphoric acid can be furnished in part by bone-meal. Apply liberally in soil at the start, and later, apply every week one-half ounce nitrate of soda to every 10 square feet of soil surface and once in two weeks use for the same area one ounce of dissolved rock and one ounce of sulphate of potash.

For flowering plants *grown in pots,* as in the case of house plants, the above mixture may be used at the rate of half a teaspoonful for a six-inch pot once in two to four weeks, working slightly into the soil. For larger or smaller pots, use in proportion. For potted house plants, the following mixture may be used also, when it is desired to make up small quantities for use on only a few plants: Four ounces each of nitrate of soda, sulphate of ammonia and sulphate of potash and one pound of bone-meal. They should be purchased in powdered form and then carefully mixed together. Apply as directed above.

Foliage Plants.

Use the same mixture as given above for flowers, and in addition, apply nitrate of soda to the soil once in three or four weeks at the rate of one ounce for 10 or 12 square feet. The nitrate of soda may be dissolved in water, one ounce to the gallon, and applied in solution. In applying it in this way, be careful not to get the solution on the foliage, but only on the soil.

Gooseberries.

Same as currants.

Grapes.

	Per cent.	Pounds for one acre.	Pounds of different materials for one acre.
Nitrogen	2	16 to 32	50 to 100 pounds nitrate of soda; 75 to 150 pounds dried blood.
Available phosphoric acid	8	69 to 120	400 to 800 pounds dissolved rock.
Potash	12	100 to 200	200 to 400 pounds muriate of potash.

Suggestions.— Much of the nitrogen can be supplied by growing clover between rows and turning under. Excessive use of stable manure is believed to produce a growth of weakened vitality, not able readily to withstand attacks of fungous diseases. Once in a few years lime may be applied to advantage.

Grass for Pastures.

	Per cent.	Pounds for one acre.	Pounds of different materials for one acre.
Nitrogen	4	15 to 30	100 to 200 pounds nitrate of soda.
Available phosphoric acid	8	30 to 60	200 to 400 pounds dissolved rock.
Potash	10	40 to 80	80 to 160 pounds muriate of potash.

Suggestions.— It is possible to secure rich pasturage continuously in abundance only with a good supply of available plant food. Three hundred pounds of the above mixture may be applied in the spring and an additional 200 pounds in late summer, for the purpose both of getting a good growth and also of favoring the introduction of clovers.

Grass for Meadows.

	Per cent.	Pounds for one acre.	Pounds of different materials for one acre
Nitrogen	4	15 to 30	100 to 200 pounds nitrate of soda.
Available phosphoric acid	7	30 to 60	200 to 400 pounds dissolved rock.
Potash	9	35 to 70	70 to 140 pounds muriate of potash.

Suggestions.— The fact cannot be too strongly emphasized that meadows from which the grass is cut year after year should be regularly fertilized every year in a liberal manner. Three hundred pounds of the above mixture may be applied in the spring and as much more soon after the hay is cut.

Grass for Lawns.

	Per cent.	Pounds for one acre.	Pounds of different materials for one acre.
Nitrogen	5	20 to 40	125 to 250 pounds nitrate of soda.
Available phosphoric acid	6	25 to 50	175 to 350 pounds dissolved rock.
Potash	8	30 to 60	60 to 120 pounds muriate of potash.

Suggestions.— Where the soil is prepared for seeding, there should be a liberal application of plant food, say 500 pounds or more of the above mixture. After the lawn is well started, an application of the above mixture at the rate of 100 pounds an acre in spring after the grass is well started, and once or more later in summer will suffice. Nitrate of soda alone gives good results applied two or three times as a top-dressing during the season. In applying either the above mixture or nitrate of soda alone to grass, it will be well to dilute by mixing with muck, sifted ashes, or land plaster. Unless this is done, there is danger that the grass will be burned where the undiluted fertilizer comes in contact with the grass in considerable amounts.

Greenhouse Crops.

Same as for flowering plants grown in a greenhouse.

Hops.

	Per cent.	Pounds for one acre.	Pounds of different materials for one acre.
Nitrogen	3	20 to 40	50 to 100 pounds nitrate of soda; 75 to 150 pounds dried blood; 75 to 150 pounds cotton seed meal.
Available phosphoric acid	6	35 to 70	250 to 500 pounds dissolved rock.
Potash	12	80 to 160	160 to 320 pounds muriate of potash.

Suggestions.— Stable manure supplemented by commercial forms of plant food may be used to advantage.

Horse Radish.

	Per cent.	Pounds for one acre.	Pounds of different materials for one acre.
Nitrogen	4	15 to 30	50 to 100 pounds nitrate of soda; 75 to 150 pounds dried blood.
Available phosphoric acid	6	25 to 50	175 to 350 pounds dissolved rock.
Potash	9	35 to 70	70 to 140 pounds muriate of potash.

House Plants.

Same as for flowers and flowering house plants and foliage plants.

Lettuce.

	Per cent.	Pounds for one acre.	Pounds of different materials for one acre.
Nitrogen	5	40 to 80	100 to 200 pounds nitrate of soda; 150 to 300 pounds dried blood; 125 to 250 pounds cotton seed meal or ground fish.
Available phosphoric acid	6	50 to 100	350 to 700 pounds dissolved rock.
Potash	9	75 to 150	150 to 300 pounds muriate of potash.

Suggestions.— Apply the above mixture at time of planting and when plants are well started use per acre 100 pounds of nitrate of soda as top-dressing. For growing lettuce under glass, see under greenhouse crops.

Millet.

Same as for meadow grass.

Muskmelons.

Same as for cucumbers.

Nursery Stock.

	Per cent.	Pounds for one acre.	Pounds of different materials for one acre.
Nitrogen	3	10 to 20	25 to 50 pounds nitrate of soda; 100 to 200 pounds cotton seed meal.
Available phosphoric acid	6	25 to 50	175 to 350 pounds dissolved rock.
Potash	7	30 to 60	60 to 120 pounds muriate of potash.

Suggestions.— An occasional liming is very desirable on many soils. When stable manure is used, it should be applied in small quantities and supplemented by phosphoric acid and potash. Excess of nitrogen produces a rapid growth of wood, but such wood is too succulent to be strong and, it is believed, is more easily attacked by plant diseases.

Oats.

	Per cent.	Pounds for one acre.	Pounds of different materials for one acre.
Nitrogen	4	12 to 24	75 to 150 pounds nitrate of soda.
Available phosphoric acid	7	20 to 40	125 to 250 pounds dissolved rock.
Potash	5	15 to 30	30 to 60 pounds muriate of potash.

Suggestions.— When oats are grown with peas for forage, it is advisable to use more phosphoric and potash than are indicated above.

Onions.

	Per cent.	Pounds for one acre.	Pounds of different materials for one acre.
Nitrogen	5	50 to 100	100 to 200 pounds nitrate of soda; 200 to 400 pounds dried blood; 200 to 400 pounds cotton seed meal.
Available phosphoric acid	8	80 to 160	500 to 1,000 pounds dissolved rock.
Potash	10	100 to 200	200 to 400 pounds muriate of potash.

Suggestions.— Additional applications of nitrate of soda at the rate of 50 pounds an acre may be made as a top-dressing twice after the crop is well started, at intervals of three weeks.

Fresh stable manure is to be avoided on account of weed seeds, and also a tendency to favor the growth of onion maggots. Stable manure is preferably used in soil two years before planting onions. An excess of nitrogen delays the ripening and injures the keeping qualities of onions.

Parsnips.

	Per cent.	Pounds for one acre.	Pounds of different materials for one acre.
Nitrogen	4	20 to 40	25 to 50 pounds nitrate of soda; 100 to 200 pounds dried blood; 100 to 200 pounds cotton seed meal.
Available phosphoric acid	8	40 to 80	300 to 600 pounds dissolved rock.
Potash	10	50 to 100	100 to 200 pounds muriate of potash.

Peaches.

	Per cent.	Pounds for one acre.	Pounds of different materials for one acre.
Nitrogen	2	15 to 30	25 to 50 pounds nitrate of soda; 50 to 100 pounds dried blood; 100 to 200 pounds cotton seed meal.
Available phosphoric acid	5	40 to 80	300 to 600 pounds dissolved rock.
Potash	7	60 to 120	120 to 240 pounds muriate of potash.

Suggestions.—The application should be made early and worked into the soil. Much of the needed nitrogen may be furnished by means of clover crops grown between the rows of trees and turned under as green manure, but care must be taken not to accumulate an excess of nitrogen in the soil in this way, because this condition favors abnormal growth of wood and delays ripening of fruit.

Pears.

Same as for apples.

Peas.

Same as for beans.

Suggestions.— When peas are raised for picking green, larger amounts of nitrate of soda can be used to advantage.

Plums.

Same as for cherries.

Potatoes.

	Per cent.	Pounds for one acre.	Pounds of different materials for one acre.
Nitrogen	4	30 to 60	50 to 100 pounds nitrate of soda; 50 to 100 pounds sulphate of ammonia; 200 to 400 pounds cotton seed meal.
Available phosphoric acid	8	60 to 120	400 to 800 pounds dissolved rock.
Potash	10	100 to 200	200 to 400 pounds muriate or sulphate of potash.

Suggestions.— The use of stable manure appears to favor the growth of potato scab. When used, stable manure should be applied to a preceding crop. Wood ashes and lime are also reported to favor the attack of the scab.

Pumpkins.

Same as for cucumbers.

Quinces.

Same as for apples.

Radishes.

	Per cent.	Pounds for one acre.	Pounds of different materials for one acre.
Nitrogen	4	15 to 30	50 to 100 pounds nitrate of soda; 75 to 150 pounds dried blood.
Available phosphoric acid	8	35 to 70	250 to 500 pounds dissolved rock.
Potash	10	40 to 80	80 to 160 pounds muriate of potash.

Raspberries.

Same as for blackberries.

Rhubarb.

Use same application as for lettuce, applying early in spring. About two weeks after beginning to cut for market, apply and cultivate into soil 100 pounds of nitrate of soda per acre and another equal amount after completing the cutting for the season.

Roses.

Same as for flowers.

Rye.

Same as for oats.

Suggestions.— Nitrogen is preferably applied in the form of nitrate of soda rather than stable manure, and excessive use of nitrogen should be avoided, when crop is grown for grain. For forage and green manure, larger amounts of nitrogen are useful.

Sorghum.

Same as for corn.

Spinach.

Same as for lettuce.

Squashes.

Same as for cucumbers.

Strawberries.

	Per cent.	Pounds for one acre.	Pounds of different materials for one acre.
Nitrogen	8	25 to 50	50 to 100 pounds nitrate of soda; 100 to 200 pounds dried blood; 100 to 200 pounds cotton seed meal.
Available phosphoric acid	7	55 to 110	375 to 750 pounds dissolved rock.
Potash	9	75 to 150	150 to 300 pounds muriate of potash.

Suggestions.— Apply about 800 pounds of this mixture per acre before the plants are set. The next spring, preceding the first crop, make the same application. It may also be found good practice to apply top-dressing of nitrate of soda at the rate of 100 pounds an acre after the plants have blossomed.

Sugar Beets.

See under beets.

Tobacco.

	Per cent.	Pounds for one acre.	Pounds of different materials for one acre.
Nitrogen	6	60 to 120	100 to 200 pounds nitrate of soda; 100 to 200 pounds sulphate of ammonia; 100 to 200 pounds dried blood; 200 to 400 pounds cotton seed meal.
Available phosphoric acid	6	60 to 120	400 to 800 pounds dissolved rock.
Potash	10	100 to 200	200 to 400 pounds sulphate of potash.

Tomatoes.

	Per cent.	Pounds for one acre.	Pounds of different materials for one acre.
Nitrogen	4	25 to 50	75 to 150 pounds nitrate of soda; 150 to 300 pounds dried blood.
Available phosphoric acid	8	50 to 100	350 to 700 pounds dissolved rock.
Potash	10	60 to 120	120 to 240 pounds muriate of potash.

Suggestions.— For early tomatoes apply the above mixture previous to, or at the time of, setting plants. Three or four weeks later apply 100 pounds per acre of nitrate of soda, distributing around the hill. To make sure of even distribution this may be diluted with earth, land plaster, sifted coal ashes or similar material.

Turnips.

Same as for beets grown for fodder.

Watermelons.

Same as for cucumbers.

Wheat.

	Per cent.	Pounds for one acre.	Pounds of different materials for one acre.
Nitrogen	4	12 to 24	50 to 100 pounds nitrate of soda; 50 to 100 pounds dried blood.
Available phosphoric acid	7	20 to 40	150 to 300 pounds dissolved rock.
Potash	4	12 to 24	25 to 50 pounds muriate of potash.

PART IV.

THE ARITHMETIC OF FERTILIZERS.

When we desire to know the amount of nitrogen, potash and phosphoric acid contained in different forms and materials, or to make up formulas from materials of known composition, or to determine the commercial value of any single material or of any mixture, it is necessary to go through various mathematical processes, most of which are comparatively simple and easily understood. So many inquiries are made about questions involving simple calculations, that it is thought advisable to present a somewhat systematic consideration of some of the more common problems met with. Some calculations, which it might be desirable to use at times, involve more knowledge of chemistry than can be given in a simple treatise of this kind.

Before taking up a consideration of the mathematical details, we will make a brief explanation of the different terms used in expressing fertilizer guarantees and analyses, because an accurate knowledge of such terms is important, especially in making commercial valuations and in planning formulas.

We shall, therefore, consider under the general head given above the following topics:

1. Explanation of terms used in stating guarantee analyses of fertilizers.
2. Total constituents of fertilizers.
3. Commercial valuation of fertilizers.
4. How to calculate amounts of materials to be used in making home-made fertilizers.

1. EXPLANATION OF TERMS USED IN STATING GUARANTEE ANALYSES OF FERTILIZERS.

In examining the guarantee analyses of different manufacturers, we find much variation in the terms used. Some forms are simple, stating only the most essential points, while others are complicated and confusing to the average farmer. We purpose here briefly to explain all the different forms which are apt to be met. The following list contains most of the terms used in stating manufacturers' guarantee analyses:

NITROGEN is expressed as

(*a*) Nitrogen, (*b*) ammonia, (*c*) nitrogen equal (or equivalent) to ammonia.

PHOSPHORIC ACID is expressed as

(*a*) Phosphoric acid, (*b*) soluble phosphoric acid, (*c*) reverted phosphoric acid, (*d*) precipitated phosphoric acid, (*e*) available phosphoric acid, (*f*) soluble and available phosphoric acid, (*g*) insoluble phosphoric acid, (*h*) total phosphoric acid, (*i*) phosphoric acid equal (or equivalent) to bone phosphate of lime.

POTASH is expressed as

(*a*) Potash, (*b*) potash (actual), (*c*) potash s. (or sul.), (*d*) potash (soluble), (*e*) potash as sulphate, (*f*) potash equal (or equivalent) to sulphate of potash, (*g*) sulphate of potash, (*h*) potassium oxide.

NITROGEN.

(*a*) *Nitrogen* is a gas and, in this form, cannot be used in fertilizers. Therefore, whenever we speak of nitrogen in fertilizers, we do not mean that nitrogen exists in them as simple nitrogen. As previously stated, the nitrogen in fertilizers is always combined with other elements and may be present in one or more different forms: (1) in the form of nitrates, as nitrate of soda; (2) in the form of ammonia compounds, as sulphate of ammonia; and (3) in the form of organic matter, animal or vegetable, as dried blood, meat, tobacco stems, etc. Chemical analysis frequently does not ascertain and state in which form or forms the nitrogen is present in a fertilizer.

When, therefore, nitrogen is expressed in an analysis or guarantee simply as "nitrogen," it refers to the entire amount of nitrogen present without regard to the particular form or forms in which it is present.

(*b*) *Ammonia consists of nitrogen combined with hydrogen.*—A pound of nitrogen will form more than a pound of ammonia, because the ammonia formed from a pound of nitrogen will contain that pound of nitrogen plus the necessary amount of hydrogen added to form ammonia. The chemical relations of nitrogen and ammonia are such that 14 pounds of nitrogen will unite with exactly three pounds of hydrogen, and will, therefore, produce just 17 pounds of ammonia; or one pound of nitrogen will make 1.214 pounds of ammonia.

Manufacturers very commonly express the amount of nitrogen in the equivalent of ammonia, probably for the reason that, expressed as ammonia, larger figures are obtained than would be, if expressed as nitrogen; and the fertilizers appear to farmers to contain more nitrogen. *Farmers should know that "nitrogen" and "ammonia" are not the same thing, since one pound of ammonia contains only about eight-tenths of a pound of nitrogen.*

(*c*) *Nitrogen equal* (*or equivalent*) *to Ammonia* is a form of expression which simply means that the nitrogen is stated not as nitrogen but as ammonia.

It would be better on every account if all guarantees stated simply nitrogen and never mentioned ammonia at all. As a matter of fact, compounds of ammonia are quite uncommon in commercial fertilizers, because nitrogen in this form is generally the most expensive and, therefore, least used. Strictly speaking, the term ammonia should never be used except when sulphate of ammonia or some similar compound is present in the fertilizer.

PHOSPHORIC ACID.

(*a*) *Phosphoric Acid,* as used in connection with fertilizers, is a compound containing phosphorus and oxygen, which in fertilizers is found never by itself, but in combination with lime. Phosphoric acid stands for a certain amount of phosphate of lime. We may say roughly that one part of phosphoric acid is equivalent to about two parts of phosphate of lime. But we know that phosphoric acid exists in several different forms. (See page 227.)

(*b*) *Soluble Phosphoric Acid* represents the amount of phosphate of lime that dissolves easily in water. As explained already, soluble calcium phosphate is formed by treating with sulphuric acid some form of insoluble calcium phosphate, such as bones, bone ash, South Carolina rock, etc. The phosphate thus formed is readily soluble in water.

(*c*) *Reverted Phosphoric Acid* is formed from soluble phosphoric acid under certain conditions into which we need not inquire here. Suffice it to say, that the soluble compound of phosphoric acid often changes, to some extent, on standing, into a form, which, while less soluble, is still quite readily available as plant food.

(*d*) *Precipitated Phosphoric Acid* is simply another name for the reverted form.

(*e*) *Available Phosphoric Acid* includes both the soluble and reverted forms of phosphoric acid, because both forms are available for the use of plants.

(*f*) *Soluble and Available Phosphoric Acid* is an expression which means the same as available.

(*g*) *Insoluble Phosphoric Acid* represents that form of phosphate of lime which is insoluble in water and ammonium citrate solution and which is of least value for agricultural purposes.

(*h*) *Total Phosphoric Acid* represents the entire phosphoric acid compounds without regard to the forms in which they exist. The total phosphoric acid is, therefore, the sum of the soluble, reverted and insoluble forms, or, to state it in another way, the sum of the available and insoluble forms.

(*i*) *Phosphoric Acid equal* (*or equivalent*) *to Bone Phosphate of Lime* is an expression which usually means nothing more or less than insoluble phosphoric acid. The expression is apt to be misleading, as it appears to imply that the phosphoric acid is derived from bone. It is applied probably to ground rock even more often than to bone. The expression is used often apparently for the sole purpose of misleading the farmer into thinking that the phosphoric acid has come from bone and also because, stated in this form, there appears to be twice as much phosphoric acid.

POTASH.

(*a*) *Potash,* as used in connection with fertilizers, always means a compound containing potassium and oxygen, known as potassium oxide. Potash or potassium oxide is never found as such in fertilizers, but chemists use this form of expressing the results of analysis as a convenient standard for reference. Fertilizers generally contain potash in such forms as sulphate of potash, muriate of potash or carbonate of potash. Instead of stating the amount of sulphate, muriate or carbonate of potash present in a fertilizer, its equivalent amount is stated only in the form of potash in giving the results of analysis.

(*b*) *Potash Actual* is simply another expression for potash, as distinct from the sulphate, muriate, etc.

(*c*) *Potash S.* (*or Sul.*) means sulphate of potash. This is quite often used by manufacturers in giving guarantees. It is very misleading and, when used, is evidently employed for the purpose of making purchasers think that it is actual potash. One pound of potash is equivalent to 1.85 pounds of sulphate of potash; and so, in stating a guarantee as sulphate, the manufacturer makes it appear that his goods contain more potash than they really do.

(*d*) *Potash Soluble* represents the amount of potash that dissolves in water and is available for the use of the plants. The different forms of potash commonly used in fertilizers are readily soluble in water.

(*e*) *Potash as Sulphate* means simply sulphate of potash.

(*f*) *Potash equal* (*or equivalent*) *to Sulphate of Potash* is an expression which means simply sulphate of potash. When the potash is present as muriate, this expression should never be used.

(*g*) *Sulphate of Potash* signifies, or should signify, that this compound is actually present in the fertilizer and there is no muriate of potash present.

(*h*) *Potassium Oxide* means the same as potash or actual potash.

ADVICE REGARDING GUARANTEE ANALYSES.— When a farmer purchases either a mixed fertilizer or separate fertilizing materials, he should purchase only under a guarantee of specified amounts of plant food. Moreover, he should insist that the guarantee be in the following terms:

Nitrogen for all forms of nitrogen. An added statement as to whether the nitrogen comes from nitrate, ammonia compounds, dried blood, cotton seed meal, etc., is desirable.

Available Phosphoric Acid or preferably water soluble and reverted phosphoric acid separately for all forms of phosphoric acid.

Potash actual for all forms of potash, though it may be desirable to have stated *in addition* whether the potash is present as sulphate free from chloride or as muriate.

In examining a guarantee, pay attention only to the nitrogen, available phosphoric acid and actual potash, and require the guarantee to be in these terms before purchasing.

2. TOTAL CONSTITUENTS OF FERTILIZERS.

If we add together the figures representing the different constituents of a fertilizer appearing in a chemical analysis (the nitrogen, the total phosphoric acid, and the potash), we shall find, as a rule, that the sum amounts to only 20 or 30 per cent. or pounds per hundred. The question often arises, "Why does the sum of the constituents in the analysis of a fertilizer amount to only 20 or 30 per cent., and what is the remaining portion, amounting to 70 or 80 per cent. made up of?" A few illustrations will, perhaps, suffice to make the matter clear.

HIGH-GRADE FERTILIZERS.— Taking a fairly high-grade fertilizer, we find by analysis that it contains:

	Per cent.
Nitrogen	4
Available phosphoric acid	8
Insoluble phosphoric acid	2
Potash	10

If the nitrogen comes from dried blood or meat, it will take about 10 pounds of such material to furnish one pound of nitrogen. Since there are four per cent. of nitrogen, or four pounds of nitrogen in 100 pounds of fertilizer, it will take 40 pounds of dried blood to furnish this amount of nitrogen. The amount of bone and sulphuric acid necessary to make a phosphate containing eight pounds of available phosphoric acid and two pounds of insoluble phosphoric acid would amount to about 40 pounds. If the potash is present in form of high-grade sulphate, about 20 pounds of such sulphate would be required to be equivalent to 10 pounds of potash. Tabulating the foregoing figures, we have the following:

	Pounds.
Dried blood required to furnish four pounds of nitrogen,	40
Bone and sulphuric acid required to furnish phosphates containing eight pounds of available and two pounds of insoluble phosphoric acid	40
Sulphate of potash equivalent to 10 pounds of potash...	20
Total	100

In a fertilizer of this character, we can easily account for the entire amount of material.

LOW-GRADE FERTILIZERS.— Taking now a low-grade fertilizer, we find its composition to show:

	Per cent
Nitrogen	1
Available phosphoric acid	5
Insoluble	1
Potash	1

We will suppose that the nitrogen and phosphoric acid come from the sources as indicated above and that the potash comes from kainit, eight pounds of kainit containing one pound of potash. Then we can tabulate our statement as follows:

	Pounds.
Dried blood required to furnish one pound of nitrogen,	10
Bones, etc., required to furnish five pounds of available and one pound insoluble phosphoric acid..........	24
Kainit equivalent to one pound of potash............	8
Moisture, land plaster, dried earth, ground rock, etc...	58
Total	100

We could, of course, vary the sources of materials used and get other figures, but these illustrations serve to give a fair idea of what a hundred pounds of fertilizer may be made, and why a statement of analysis does not account for more than 20 or 30 pounds of fertilizing materials in a hundred pounds of fertilizer.

3. COMMERCIAL VALUATION OF FERTILIZERS.

WHAT IS A COMMERCIAL VALUATION OF A FERTILIZER?— The commercial valuation of a fertilizer consists in estimating the approximate value or money cost of the essential fertilizing ingredients (nitrogen, phosphoric acid, and potash) in one ton of fertilizer.

In making a commercial valuation of a fertilizer, one uses either the figures given in the guarantee analysis or preferably the figures given in the official State analysis, as a basis for calculation. This enables one to know how many pounds of nitrogen, of phosphoric acid and of potash there are in one ton of fertilizer.

The prices to be used in calculating a commercial valuation are furnished in a schedule prepared annually by experiment stations. This price list for the year 1899 we give below.

PRICES OF NITROGEN, PHOSPHORIC ACID AND POTASH ADOPTED BY EXPERIMENT STATIONS.— The trade values in the following schedule represent the average prices at which, in the six months preceding March the respective ingredients, in the form of unmixed raw materials, could be bought at retail for cash in our large markets, Boston, New York and Philadelphia. These prices also correspond to the average wholesale prices for the six months preceding March, plus about 20 per cent. in case of goods for which there are wholesale quotations.

It must be kept in mind that these trade values are changing from time to time. In the fertilizer bulletins, which are issued by the New York State Agricultural Experiment Station at Geneva, the latest trade values are always given. Whenever in the following pages reference is made to the price list, consult the latest.

SCHEDULE OF VALUES FOR FERTILIZER INGREDIENTS, 1901.

	Cents per pound.
Nitrogen, in ammonia salts	16½
in nitrates	14
in dry and fine ground fish, meat and blood, and in mixed fertilizers	16
in cotton seed meal and castor pomace	14
in fine bone and tankage	16
in coarse bone and tankage	12
Phosphoric acid, soluble in water	5
soluble in ammonium citrate	4½
insoluble in ammonium citrate, in bone fertilizers	2
Phosphoric acid in fine bone, tankage and fish	4
Phosphoric acid in coarse bone and tankage	3
Phosphoric acid in cotton seed meal, castor pomace and wood ashes	4
Potash in high grade sulphate and in forms free from muriate (or chloride)	5
as muriate	4¼

Potash in excess of that equivalent to the chlorine present is to be valued as sulphate, and the remainder as muriate.

Nitrogen in mixed fertilizers is to be valued as derived from the best sources of organic nitrogen, unless clear evidence to the contrary is obtained.

Bone is sifted into two grades of fineness: Fine, less than 1-50 inch in diameter; coarse, over 1-50 inch in diameter.

The result obtained by the use of these valuations does not cover the items of mixing, bagging, freight and agents' commission.

VALUATION AND COST OF FERTILIZERS.— The total cost (to the farmer) of a ton of commercial fertilizer may be regarded as consisting of the following elements: (1) Retail cash cost, in the market, of unmixed trade materials; (2) cost of mixing and bagging; (3) cost of transportation; (4) storage, commissions to agents and dealers, selling on long credit, bad debts, etc. While the *total cost* of a fertilizer is made up of several different elements, a *commercial valuation* includes only the first of the elements entering into the total cost, that is, the retail cash cost in the market of unmixed raw materials.

VALUATION AND AGRICULTURAL VALUE.— The *agricultural value* of a fertilizer depends upon its *crop-producing power.* A commercial valuation does not necessarily have any relation to crop-producing value. For a particular soil and crop, a fertilizer of comparatively low commercial valuation may have a higher agricultural value; while for another crop on the same soil or the same crop on another soil the reverse might be true.

SIMPLE RULE FOR CALCULATING APPROXIMATE COMMERCIAL VALUATION OF FERTILIZERS.

Multiply the per cent. of nitrogen by three and add to the product the figures representing the per cent. of available phosphoric acid and of potash. The sum expresses in dollars and cents the approximate commercial valuation of the fertilizer.

Example.— A fertilizer contains

	Per cent.
Nitrogen	4.13
Available phosphoric acid	8.52
Potash	10.54

4.13 (per cent. of nitrogen) multiplied by three, equals,	$12 39
8.52 (per cent. of available phosphoric acid)	8 52
10.54 (per cent. of potash)	10 54
Total, per ton	$31 45

If a fertilizer contains only one or two of the three essential fertilizing ingredients, the rule can be applied in a modified form. In case of fine bone meal, use the total phosphoric acid in place of the available in making the calculation.

While this rule is not exact, it gives results that are fairly accurate and has the great advantage of simplicity. Results obtained by this rule will be somewhat higher than those given by the longer method of calculation. It will be found satisfactory commonly in making comparison of different mixed fertilizers.

For the benefit of those who desire a more exact method of calculating the commercial valuation of fertilizers, we give below a more detailed rule. But previously we give methods for calculating from one compound to another, and also methods for making valuations of unmixed fertilizing materials.

RULES FOR CALCULATING FROM ONE COMPOUND INTO OTHER COMPOUNDS.

(a) *Compounds Containing Nitrogen.*

(1) *To change ammonia into an equivalent amount of nitrogen,* multiply the amount of ammonia by 0.82.

(2) *To change nitrogen into an equivalent amount of ammonia,* multiply the amount of nitrogen by 1.21.

(3) *To change nitrate of soda into an equivalent amount of ammonia,* divide the amount of nitrate of soda by 5 (or multiply by 0.20).

(4) *To change nitrate of soda into an equivalent amount of nitrogen,* divide the amount of nitrate of soda by 6 (or multiply by 0.165).

(5) *To change nitrogen into an equivalent amount of nitrate of soda,* multiply the nitrogen by 6.

(6) *To change sulphate of ammonia into an equivalent amount of ammonia,* divide the amount of pure sulphate of ammonia by 4.

(7) *To change ammonia into an equivalent amount of sulphate of ammonia,* multiply the amount of ammonia by 4.

(8) *To change nitrate of potash into an equivalent amount of nitrogen,* divide the amount of nitrate of potash by 7.2.

(b) *Compounds Containing Potash.*

(9) *To change muriate of potash into an equivalent amount of actual potash,* multiply the amount of muriate by 0.63.

(10) *To change actual potash into an equivalent amount of muriate of potash,* multiply the amount of actual potash by 1.6.

(11) *To change sulphate of potash into an equivalent amount of actual potash,* multiply the amount of sulphate of potash by 0.54.

(12) *To change actual potash into an equivalent amount of sulphate of potash,* multiply the amount of actual potash by 1.85.

(13) *To change nitrate of potash into an equivalent amount of actual potash,* multiply the amount of nitrate of potash by 0.46.

(14) *To change actual potash into an equivalent amount of nitrate of potash,* multiply the amount of actual potash by 2.15.

(c) *Compounds Containing Phosphoric Acid.*

(15) *To change bone phosphate into an equivalent amount of phosphoric acid,* multiply by 0.46.

(16) *To change phosphoric acid into an equivalent amount of bone phosphate,* multiply by 2.2.

RULES FOR MAKING VALUATIONS OF UNMIXED FERTILIZING MATERIALS.

(a) *Materials Containing Nitrogen.*

(1) *Sulphate of Ammonia. Rule. Multiply the given per cent. of ammonia by* 0.82 *and this product by the price of one pound of nitrogen in the form of ammonia* (see price list on page 309). *Multiply this product by* 20.

Example.— A sample of ammonium sulphate tests 24 per cent. ammonia; what is its commercial valuation?

24 per cent. of ammonia) × 0.82 = 19.68 per cent. of nitrogen.

19.68 × 15 cents = 295 cents, value of nitrogen in 100 pounds of ammonium sulphate.

295 cents × 20 = $59, value of nitrogen in one ton of ammonium sulphate.

(2) *Nitrate of Soda. Rule. Multiply the test per cent. of nitrate of soda by* 16½ *and this product by the price of one pound of nitrogen in the form of nitrates* (see price list on page 309). *Multiply the last result by* 20.

Example.— What is the valuation of one ton of nitrate of soda which tests 98 per cent.?

"Nitrate of soda testing 98 per cent." means that in every 100 pounds of material there are 98 pounds of pure nitrate of soda.

98 × 0.165 = 16.17 per cent. nitrogen in nitrate of soda.

16.17 × 12½ cents = 202 cents × 20 = $40.40 a ton.

When the per cent. of nitrogen is given, then the first step is omitted.

(b) *Materials Containing Phosphoric Acid.*

(1) *Available Guaranteed. Rule. Multiply the given amount of available phosphoric acid by the price of one pound of soluble phosphoric acid* (see price list on page 309) *and the result by* 20.

If the amount of insoluble phosphoric acid is given, multiply this by 40 and add to foregoing amount.

Example: What is the commercial valuation of one ton of dissolved bone black testing 16 per cent. of available phosphoric acid?

16 × 4½ cents = 72 cents × 20 = $14.40 a ton.

If this sample were known also to contain two per cent. of insoluble phosphoric acid, then

2 × 40 cents = 80 cents and $14.40 + 0.80 = $15.20.

(2) *Bone Phosphate of Lime Guaranteed. Rule. Multiply the given amount of bone phosphate of lime by* 0.46 *and this product by the price of one pound of phosphoric acid in bone* (see price list on page 309).

Example: What is the commercial valuation of one ton of fine bone containing 50 per cent. bone phosphate of lime?

50 × 0.46 = 23, the per cent. of phosphoric acid in the bone.

23 × 3½ cents = 80.5 cents × 20 = $16.10 a ton.

(c) *Materials Containing Potash.*

(1) *Sulphate of Potash. Rule. Multiply the test per cent. sulphate of potash by* 0.54 *and the product by the price of one pound of potash in the form of sulphate* (see price list on page 309). *Multiply this product by* 20.

Example: What is the commercial valuation of one ton of sulphate of potash which tests 50 per cent. (low-grade) sulphate?

50 × 0.54 = 27 per cent. of actual potash.

27 × 5 cents = $1.35, value of 100 pounds of sulphate of potash.

$1.35 × 20 = $27, value of one ton of sulphate of potash testing 50 per cent. sulphate.

Example: What is the valuation of one ton of sulphate of potash which tests 95 per cent. (high-grade) sulphate of potash?

95 × 0.54 = 51.3 per cent. of actual potash.

51.3 × 5 cents = 256.4 cents × 20 = $51.30 value of one ton of sulphate of potash testing 95 per cent. sulphate.

When the per cent. of actual potash is given, the first step can be omitted, and the per cent. of actual potash multiplied by the price per pound and then by 20.

(2) *Muriate of Potash. Rule. Multiply the given per cent. of muriate by* 0.63 *and the result by the price of one pound of potash in the form of muriate* (see price list on page 309). *Multiply this result by* 20.

Example: What is the valuation of one ton of muriate of potash testing 85 per cent. muriate?

85 × 0.63 = 53.55 per cent. of actual potash. 53.55 × 4 cents = 228 cents × 20 = $45.60 a ton.

SECOND METHOD FOR MAKING COMMERCIAL VALUATIONS OF MIXED FERTILIZING MATERIALS.

Rule. Multiply the given per cent. of each constituent (nitrogen, phosphoric acid and potash) by its list price, add the products and multiply the sum by 20.

Example: What is the valuation of one ton of a commercial fertilizer having the following guarantee analysis?

	Per cent.
Nitrogen	2 (to 3)
Available phosphoric acid	8 (to 10)
Potash	3 (to 5)

In each case where a guarantee analysis gives two figures, always use the lower, because the law takes only the lower guarantee into consideration.

	Cents.
Two (per cent. nitrogen) × 14 cents (price of one pound nitrogen) =	0.28
Eight (per cent. av. phos. acid) × 5 cents (price of one pound av. phos. acid) =	0.40
Three (per cent. potash) × 5 cents (price of one pound potash) =	0.15
Total value of 100 pounds of fertilizers =	0.83

0.83 cents × 20 = $16.60 a ton.

When the nitrogen is given only in the form of ammonia, first change to equivalent of nitrogen (see (1), page 311) and then follow above rule.

When the phosphoric is given only in the form of bone phosphate of lime, first change to equivalent of phosphoric acid (see (*c*) (15), page 311) and then follow above rule.

When the potash is given only in the form of sulphate or muriate, first change to equivalent of actual potash (see (9) and (11), page 311) and then follow rule.

4. HOW TO CALCULATE AMOUNTS OF MATERIALS TO BE USED IN MAKING A HOME-MADE FERTILIZER.

There will probably be little demand for information in regard to quantities of different materials to be used in making home-made fertilizers, since the subject is treated in a specific manner on pages 283–301. But it will, at least, be of interest to learn how different materials may be put together to make up a given formula.

Suppose that we desire to make one ton of a mixture containing —

	Per cent.
Nitrogen	4
Available phosphoric acid	8
Potash	10

Suppose, in addition, that we have on hand for our purpose the following materials:

Nitrate of soda containing 16 per cent. of nitrogen.

Acid phosphate containing 15 per cent. of available phosphoric acid.

Muriate of potash containing 50 per cent. of actual potash.

How many pounds of each of these materials shall we take to make one ton of a mixture having the composition given above?

To contain four per cent. of nitrogen, the ton must contain 80 pounds. The material which we use contains 16 pounds of nitrogen in 100 pounds, and hence 500 pounds of nitrate of soda would be required to furnish 80 pounds of nitrogen.

To contain eight per cent. of available phosphoric acid, the ton must contain 160 pounds. Our material contains in 100 pounds 15 pounds of available phosphoric acid and hence 1,067 pounds of acid phosphate would be required to furnish 160 pounds of available phosphoric acid.

To contain 10 per cent. of actual potash, the ton must contain 200 pounds. Our muriate of potash is one-half actual potash, and hence 400 pounds of muriate would be required to furnish 200 pounds of actual potash.

We should, then, have the following amounts of materials to be used for one ton of fertilizer:

500	pounds nitrate of soda.
1,067	pounds acid phosphate.
400	pounds muriate or potash.
1,967	

1,967 pounds of these mixed materials furnish the amounts of nitrogen, potash and phosphoric acid we need for one ton of our formula. How shall we make the mixture up to one ton? We simply add 33 pounds of sand, land plaster or other inert matter as a "filling," and we thus obtain one ton of a fertilizer having the composition given above.

By adding one more ton of filling, we should have two tons of a fertilizer of the following composition:

	Per cent.
Nitrogen	2
Available phosphoric acid	4
Potash	5

PART V.

AVERAGE COMPOSITION AND VALUE OF DIFFERENT FERTILIZING MATERIALS AND OF FARM CROPS. TABULATED COMPILATION.

In the tables following, we present a compilation of data, showing the manurial composition and value of a large number of different kinds of materials. The different kinds of materials given are tabulated and presented under the following heads:

1. Materials used in fertilizers.
2. Hay and dry coarse fodders.
3. Green fodders.
4. Straw, chaff, leaves, etc.
5. Roots, bulbs, tubers, etc.
6. Grains and other seeds.
7. Mill products.
8. Fruits.
9. Vegetables.
10. Dairy products.
11. Farm animals and animal products.
12. By-products and waste materials.
13. Animal manures.

In assigning values to nitrogen, phosphoric acid and potash contained in materials not found regularly in the market as fertilizing materials, there is difficulty in fixing a price that will represent their real manurial value as compared with the most available forms common in the market. In the following tables the regular schedule values have been used for these materials that are recognized in the market and also for such materials as closely resemble any of these. For most vegetable materials, the price of nitrogen has been fixed at twelve cents a pound, that of phosporic acid and potash at four cents a pound. These are probably fair values, when we take the availability into consideration, and this should be done in order not to overestimate the fertilizing value of many materials.

1. Materials Used in Fertilizers.

	Pounds of nitrogen in 2,000 pounds of material.	Pounds of Phosphoric acid in 2,000 pounds of material.			Pounds of potash in 2,000 pounds of material.	Approximate fertilizing valuation of 2,000 pounds.
		Available.	Insoluble.	Total.		
Apatite..................	....	....	660 to 880	660 to 800	....	$13 00 to $16 00
Ashes (anthracite coal)...........	....	....	....	2 to 3	2 to 3	15 to 20
Ashes (bituminous coal)...........	....	....	....	8 to 10	8 to 10	50 to 70
Ashes (lime-kiln)...........	....	....	....	20 to 25	20 to 30	1 50 to 2 00
Ashes (spent tan-bark)...........	....	....	....	30 to 40	30 to 50	2 00 to 3 00
Ashes (wood, leached)...........	....	....	....	20 to 30	20 to 60	1 50 to 4 00
Ashes (wood, unleached)...........	....	....	....	30 to 40	80 to 160	5 00 to 10 00
Azotin (ground meat, etc., **free from fat**)	200 to 300	....	....	60 to 80	....	35 00 to 50 00
Bone ash...........	....	....	600 to 700	600 to 700	....	12 00 to 14 00
Bone black...........	....	....	500 to 700	500 to 700	....	10 00 to 14 00
Bone black (dissolved)...........	....	240 to 360	10 to 20	260 to 360	....	10 00 to 15 00
Bone meal...........	70 to 90	80 to 160	320 to 340	400 to 500	....	27 00 to 34 00
Bone meal (free from fat)...........	100 to 120	100 to 120	300 to 380	400 to 500	....	32 00 to 40 00
Bone meal (from glue factory)...........	30 to 40	120 to 160	320 to 400	440 to 560	....	27 00 to 34 00
Bone meal (dissolved)...........	50 to 70	240 to 360	40 to 160	280 to 420	....	21 00 to 35 00
Carnallite...........	....	....	....	....	260 to 280	11 00 to 12 00
Castor bean pomace...........	100 to 120	....	....	40 to 50	20 to 25	16 00 to 20 00
Cotton seed hull ashes...........	....	140 to 160	....	160 to 180	300 to 500	21 00 to 32 00
Cotton seed meal...........	120 to 140	....	....	40 to 60	30 to 40	19 00 to 23 00
Dried blood, red...........	260 to 300	....	....	35 to 40	....	43 00 to 50 00
Dried blood, black...........	120 to 240	....	....	40 to 80	....	21 00 to 42 00
Dried fish...........	140 to 160	50 to 60	100 to 120	150 to 180	10 to 15	29 00 to 33 00
Florida rock...........	....	....	500 to 800	500 to 800	....	10 00 to 16 00
Florida soft phosphate...........	....	....	360 to 600	360 to 600	....	7 00 to 12 00
Hair...........	280 to 320	....	....	....	....	8 00 to 10 00
Hoof meal, horn dust...........	200 to 300	....	....	35 to 40	....	12 00 to 17 00
Kainit...........	....	....	....	....	240 to 280	10 00 to 12 00
Keystone concentrated phosphate...........	....	700 to 800	140 to 160	900 to 960	....	34 00 to 40 00

Krugite	....	....	....	....	160 to 180	8 00 to 9 00
Leather scraps, leather meal	140 to 160	....	....	....	....	7 00 to 8 00
Lobster shells	70 to 90	....	....	60 to 80	....	11 00 to 14 00
Marls (New Jersey green sand)	....	....	....	20 to 80	70 to 140	2 00 to 4 00
Meat scraps	200 to 240	....	....	40 to 60	....	34 00 to 40 00
Mud (fresh water)	20 to 40	....	....	4 to 5	4 to 5	3 00 to 4 00
Muriate of ammonia	500 to 520	....	....	....	....	82 00 to 85 00
Muriate of potash (80 to 85 per cent. pure)	....	....	....	....	1000 to 1060	42 00 to 45 00
Nitrate of potash	260 to 280	....	....	....	810 to 880	77 00 to 84 00
Nitrate of soda	310 to 320	....	....	....	....	43 00 to 45 00
Nitrogenous guanos	140 to 160	140 to 160	120 to 140	260 to 300	40 to 60	33 00 to 36 00
Oleomargarine refuse	200 to 240	....	....	10 to 20	....	32 00 to 38 00
Peat	15 to 20	....	....	1 to 2	2 to 4	1 50 to 2 00
Peruvian guano	140 to 160	100 to 160	100 to 140	200 to 300	40 to 60	30 00 to 38 00
Soot from wood	20 to 40	....	....	60 to 100	40 to 60	6 00 to 11 00
Soot from hard coal	40 to 60	....	....	60 to 100	20 to 40	8 00 to 13 00
South Carolina rock (ground)	....	....	500 to 600	500 to 600	....	10 00 to 12 00
South Carolina rock (floats)	....	....	500 to 600	500 to 600	....	10 00 to 12 00
South Carolina rock (dissolved)	....	200 to 240	40 to 80	240 to 320	....	10 00 to 12 50
Sulphate of ammonia	380 to 410	....	....	....	....	62 00 to 67 00
Sulphate of potash (low-grade)	....	....	....	....	560 to 600	28 00 to 30 00
Sulphate of potash (high-grade)	....	....	....	....	960 to 1020	48 00 to 51 00
Sulphate of potash and magnesia	....	....	....	....	520 to 560	26 00 to 28 00
Sylvinit	....	....	....	....	300 to 320	13 00 to 14 00
Tankage, concentrated	200 to 240	....	....	40 to 80	....	33 00 to 41 00
Tankage, crushed	80 to 180	....	....	60 to 240	....	14 00 to 37 00
Tankage, garbage	30 to 40	....	....	10 to 20	10 to 20	3 00 to 6 00
Thomas slag	....	120 to 140	240 to 260	360 to 400	....	10 00 to 11 00
Tobacco stalks	70 to 80	....	....	10 to 20	100 to 120	14 00 to 17 00
Tobacco stems	40 to 50	....	....	10 to 20	140 to 160	12 00 to 14 00
Waste from powder works	40 to 60	....	....	....	320 to 360	22 00 to 26 00
Wool-waste	100 to 120	....	....	4 to 8	20 to 60	6 00 to 9 00

Hay and Dry Coarse Fodders — Green Fodders, Etc.

	Pounds of nitrogen in one ton.	Pounds of phosphoric acid in one ton.	Pounds of Potash in one ton.	Approximate fertilizing valuation of 2,000 pounds.
2. Hay and Dry Coarse Fodders.				
Alfalfa	44.0	10.6	34.0	$7 10
Blue mellot	38.4	10.8	56.0	7 25
Buckwheat	16.7	12.2	48.4	4 45
Buckwheat (Japanese)	32.6	17.0	66.4	7 25
Buttercups	20.4	8.2	16.2	3 40
Clover (alsike)	46.6	14.0	40.2	7 75
Clover (Bokhara)	40.0	11.2	37.0	6 70
Clover (crimson)	40.0	7.6	25.0	6 10
Clover (mammoth red)	44.6	11.0	24.4	6 80
Clover (red)	42.0	10.0	40.0	7 00
Clover (white)	50.0	14.0	30.0	8 20
Corn fodder (with ears)	36.0	11.0	18.0	5 50
Corn (without ears)	22.4	6.0	28.0	4 05
Cow pea (whole plant)	39.0	10.6	29.4	4 30
Daisy (white)	5.6	8.8	25.0	2 00
Daisy (ox-eye)	6.0	9.0	25.0	2 05
French rye-grass	33.2	12.0	48.0	6 35
Hungarian grass	24.0	7.0	26.0	4 20
Italian rye-grass	23.0	11.0	25.0	4 20
June grass	21.0	7.4	29.2	3 95
Kentucky blue grass	23.8	8.0	31.4	4 45
Meadow fescue	20.0	8.0	42.0	4 40
Meadow foxtail	30.8	8.8	40.0	5 65
Millet (common)	25.6	10.0	34.0	4 80
Millet (Japanese)	22.2	8.0	24.4	3 95
Mixed grasses	28.0	7.0	30.8	4 85
Mustard	35.4	16.2	27.2	5 95
Oats (in bloom)	24.0	13.4	50.8	5 45
Orchard grass	26.2	8.2	37.6	4 95
Pea (in bloom)	66.0	10.2	34.0	9 65
Perennial rye grass	30.8	12.8	40.0	5 80
Redtop	23.0	7.2	20.4	3 85
Rowen of mixed grasses	32.0	9.0	30.0	5 40
Sainfoin	47.0	11.0	30.6	7 30
Salt marsh hay	23.6	5.0	14.4	3 60
Serradella	47.0	14.2	38.6	7 75
Soja bean (whole plant)	46.4	13.4	21.6	6 95
Tall meadow oat grass	23.2	6.4	34.4	4 40
Timothy hay	25.2	9.2	30.6	4 60
3. Green Fodders.				
Alfalfa	14.4	2.6	11.2	2 30
Buckwheat in blossom	10.2	2.2	8.6	1 65
Clover (alsike)	8.8	2.2	4.0	1 35
Clover (crimson)	8.6	2.6	9.8	1 50
Clover (red)	10.6	2.6	9.2	1 75
Clover (white)	11.2	4.0	4.8	1 70
Corn fodder	8.2	3.0	6.6	1 40

Hay and Dry Coarse Fodders — Green Fodders, Etc.— Continued.

	Pounds of nitrogen in one ton.	Pounds of phosphoric acid in one ton.	Pounds of Potash in one ton.	Approximate fertilizing valuation of 2,000 pounds.
3. Green Fodders — Continued.				
Corn fodder (silage)	5.6	2.2	7.4	1 05
Cow pea	5.4	2.0	6.2	95
Flat pea	22.6	3.6	11.6	3 00
Horse bean	13.6	6.6	27.4	2 95
Hungarian grass (German millet)	7.8	3.2	11.0	1 50
Meadow grass	8.8	3.0	12.0	1 50
Millet (common)	12.2	3.8	8.2	1 95
Millet (Japanese)	10.6	4.0	6.8	1 70
Mixed pasture grasses	18.2	4.6	15.0	2 95
Oat-fodder	9.8	2.6	7.6	1 60
Peas	10.0	3.6	11.2	1 80
Prickley comfrey	8.4	2.2	15.0	1 65
Rape	9.0	2.4	7.0	1 50
Rye fodder	9.8	4.5	14.0	1 90
Rye grass (Italian)	10.8	5.8	22.8	2 40
Rye grass (perennial)	9.4	5.6	22.0	2 25
Serradella	8.2	2.8	8.4	1 40
Soja bean	5.8	3.0	10.6	1 20
Sorghum in bloom	8.0	1.6	6.4	1 25
Timothy grass	9.6	5.2	15.2	2 00
Vetch and oats	4.8	1.8	15.9	1 30
White lupine	8.8	7.0	34.6	2 70
Yellow lupine	10.2	2.2	3.0	1 45
Young grass	10.0	4.4	23.2	2 20
4. Straw, Chaff, Leaves, etc.				
Barley-chaff	20.2	5.4	20.0	3 45
Barley-straw	26.2	6.0	41.8	4 20
Bean-shells	34.0	6.0	70.0	7 15
Beet leaves	7.0	2.0	10.0	1 35
Buckwheat hulls	12.0	8.0	20.0	2 65
Cabbage leaves	8.0	4.0	5.0	1 30
Cabbage stalks	3.6	4.8	10.2	1 00
Carrots (stalks and leaves)	10.2	4.2	7.4	1 70
Corn cobs	10.0	1.2	12.0	1 55
Corn husks	3.6	1.4	4.4	1 00
Corn stalks	5.6	2.8	8.2	1 10
Hop leaves and stems	15.0	8.0	17.6	2 80
Mangel wurzel leaves	6.0	1.6	8.2	1 10
Millet chaff	15.0	3.5	9.0	2 30
Oak leaves	16.0	6.8	3.0	2 30
Oat chaff	15.0	2.8	9.0	2 25
Oat straw	12.4	4.0	24.8	2 65
Pea shells	27.2	11.0	27.6	4 80
Pea straw (cut in bloom)	45.8	13.6	46.4	7 90

Hay and Dry Coarse Fodders — Green Fodders, Etc.— Continued.

	Pounds of nitrogen in one ton.	Pounds of phosphoric acid in one ton.	Pounds of Potash in one ton.	Approximate fertilizing valuation of 2,000 pounds.
4. Straw, Chaff, Leaves, etc.— Con't				
Pea straw (ripe)	20.8	7.0	20.2	3 55
Potato stalks and leaves	12.0	3.0	9.0	1 95
Rape straw	9.6	5.0	22.5	2 25
Rye chaff	12.0	11.0	10.0	2 30
Rye straw	9.5	5.6	18.0	2 10
Turnip stalks and leaves	6.0	2.6	4.8	1 00
Wheat chaff	15.8	14.0	8.4	2 80
Wheat straw.........................	11.8	2.4	10.2	1 92
5. Roots, Bulbs, Tubers, etc.				
Beets (red)	4.8	1.8	8.8	1 00
Beets (sugar)	5.0	2.0	10.0	1 05
Beets (yellow fodder)	3.8	1.8	9.2	90
Carrots	3.0	2.0	10.0	85
Mangolds	4.0	2.0	8.0	90
Parsnips	5.0	4.0	10.0	1 15
Potatoes	6.4	3.0	10.0	1 30
Rutabagas	4.0	2.5	10.0	1 00
Turnips	4.0	2.0	8.0	90
6. Grains and Other Seeds.				
Barley	35.0	15.0	12.0	5 30
Beans	80.0	24.0	24.0	11 50
Buckwheat	28.8	8.8	4.2	4 00
Clover	60.0	25.0	25.0	9 20
Corn kernels	36.4	14.0	8.0	5 25
Corn kernels and cobs, cob meal.....	30.0	12.0	8.8	4 45
Hempseed	50.0	35.0	20.0	8 20
Linseed	64.0	26.0	20.0	9 55
Millet (common)	40.0	15.0	8.0	5 70
Millet (Japanese)	35.0	14.0	8.0	5 10
Mustard	85.0	30.0	12.0	11 90
Oats	40.0	16.0	12.0	5 95
Peas	80.0	16.0	20.0	11 05
Rye	35.0	16.0	11.0	5 30
Soja beans	106.0	38.0	40.0	15 80
Sorghum	30.0	16.0	8.5	4 60
Sunflower	45.0	25.0	15.0	7 00
Wheat	47.0	16.0	11.0	6 75
7. Mill Products.				
Barley flour	32.0	19.0	11.5	5 05
Barley bran	35.0	18.0	16.5	5 60
Barley meal	31.0	13.0	7.0	4 50

Hay and Dry Coarse Fodders — Green Fodders, Etc.— Continued.

	Pounds of nitrogen in one ton.	Pounds of phosphoric acid in one ton.	Pounds of Potash in one ton.	Approximate fertilizing valuation of 2,000 pounds.
7. Mill Products — Continued.				
Barley middlings	40.0	35.0	14.0	6 75
Buckwheat bran	50.0	25.0	25.0	8 00
Buckwheat middlings	92.8	69.0	62.5	16 40
Corn meal	35.0	13.0	9.0	5 10
Corn and cob meal	28.0	12.0	10.0	4 25
Corn middlings	28.0	7.0	4.5	3 80
Oat bran	27.0	4.4	14.0	4 00
Oat middlings	37.0	45.0	30.5	7 45
Oats ground	37.0	15.0	12.0	5 55
Pea meal	60.0	16.0	20.0	8 95
Pea middlings	75.0	13.0	15.0	10 10
Rye bran	46.0	55.0	33.0	9 00
Rye flour	34.0	17.0	13.0	5 30
Rye middlings	40.0	25.0	18.0	6 50
Wheat bran	53.0	58.0	32.0	9 95
Wheat flour	44.0	11.4	10.6	6 15
Wheat middlings	52.5	19.0	12.5	7 55
Wheat shorts	48.4	27.5	13.0	7 41
8. Fruits.				
Apples	2.6	0.2	4.0	50
Apricots	3.8	1.2	6.0	70
Blackberries	3.0	2.0	4.0	60
Cherries	3.6	1.2	4.0	60
Grapes	3.2	1.8	5.5	70
Pears	2.0	0.6	1.6	35
Plums	3.6	0.4	5.0	65
Prunes	3.2	1.4	6.2	65
Raspberries	3.0	10.0	7.0	1 05
Strawberries	3.0	2.2	6.0	60
9. Vegetables.				
Asparagus stems	6.0	1.6	6.0	1 00
Beets (red)	5.0	2.0	9.0	1 05
Cabbages	7.6	2.2	9.0	1 30
Carrots	3.2	2.0	10.0	86
Cauliflower	2.6	3.2	7.2	75
Celery	4.8	4.4	15.0	1 35
Cucumbers	3.2	2.4	4.8	70
Horse radish root	8.0	2.0	20.0	1 85
Lettuce	4.6	1.4	7.4	90
Onions	4.0	2.5	3.5	75
Peas, garden (fresh)	23.0	6.0	8.5	3 35
Pumpkins, whole fruit	2.2	3.2	2.0	50
Rhubarb, stems and leaves	2.6	0.4	7.2	60

Hay and Dry Coarse Fodders — Green Fodders, Etc.— Continued.

	Pounds of nitrogen in one ton.	Pounds of phosphoric acid in one ton.	Pounds of Potash in one ton.	Approximate fertilizing valuation of 2,000 pounds.
9. Vegetables — Continued.				
Spinach	10.0	3.2	5.4	1 45
Sweet corn cobs	4.2	1.0	4.4	75
Sweet corn husks	3.6	1.4	4.4	65
Sweet corn kernels	9.2	1.4	4.8	1 35
Sweet corn stalks	5.6	2.8	8.2	1 10
Sweet potato	4.8	2.0	10.0	1 05
Tomatoes, fruit	3.2	1.0	5.4	65
Tomatoes, vines	6.4	1.4	10.0	1 25
10. Dairy Products.				
Butter	2.5	1.0	0.5	45
Buttermilk	10.0	3.0	3.0	1 90
Cheese, whole milk	75.0	15.0	6.0	13 00
Cheese, half skim	105.0	15.0	6.0	17 85
Cheese, separator skim	150.0	15.0	6.0	25.00
Cream	10.0	3.0	2.6	1 85
Milk	10.0	6.0	3.5	2 05
Skim milk	10.0	7.0	4.0	2 15
Whey	2.5	6.0	3.0	85
11. Farm Animals and Animal Products.				
Blood, calf	60.0	1.5	1.5	9 75
Blood, ox	65.0	1.0	1.5	10 50
Blood, sheep	65.0	1.0	1.0	10 50
Blood, swine	60.0	2.0	3.0	9 85
Eggs	45.0	7.5	3.0	7 90
Flesh, calf	70.0	12.0	8.0	12 20
Flesh, ox	72.0	9.0	10.0	12 45
Flesh, swine	70.0	9.0	8.0	12 00
Wool, unwashed	110.0	1.5	115.0	23 40
12. By-products and Waste Materials.				
Apple pomace	4.6	0.4	2.6	70
Corn cobs	10.0	1.2	12.0	1 65
Cotton seed hulls	15.0	3.6	21.6	2 80
Cotton seed meal	133.0	54.0	36.0	22 25
Glucose refuse (starch feed)	52.4	6.0	3.0	6 65
Gluten meal	100.0	6.5	1.0	14.30
Gluten feed	70.0	7.5	1.5	8 75
Chicago gluten meal	110.0	6.0	2.0	13 55
Grano gluten feed	100.0	13.0	4.0	12 70
Germ meal	70.0	12.3	6.0	9 15

Hay and Dry Coarse Fodders — Green Fodders, Etc.— Concluded.

	Pounds of nitrogen in one ton.	Pounds of phosphoric acid in one ton.	Pounds of Potash in one ton.	Approximate fertilizing valuation of 2,000 pounds.
12. By-products and Waste Materials — Continued.				
Hominy feed	32.6	20.0	10.0	5 10
Hop refuse	20.0	4.0	2.0	2 65
Linseed meal, old process	110.0	33.0	27.0	17 80
Linseed meal, new process	115.0	37.0	28.0	18 75
Malt sprouts	71.0	29.0	33.0	11 00
Spent brewers' grains, dry	61.0	25.0	31.0	9 55
Spent brewers' grains, wet	18.0	6.0	1.0	2 45
13. Animal Manures.				
Chicken manure (fresh)	30.0	25.0	15.0	5 60
Cattle manure (fresh)	5.0	6.0	4.0	1 10
Cattle urine (fresh)	11.6	......	10.0	2 40
Duck manure (fresh)	20.0	28.0	12.4	4 40
Horse manure (fresh)	11.6	5.6	10.6	2 25
Horse urine (fresh)	31.0	......	30.0	6 45
Human excrement (fresh)	16.0	12.6	5.0	2 80
Human urine (fresh)	12.0	3.4	4.0	2 30
Mixed cattle manure	9.0	5.0	8.0	1 75
Mixed horse manure	10.0	6.0	14.0	2 30
Mixed pig manure	15.0	8.0	6.0	2 50
Mixed sheep manure	20.0	2.0	24.0	3 70
Mixed stable manure	10.0	5.0	10.0	2 00

Address by Don. J. Wood, Plainfield (N. Y.) at Bridgewater Institute.

"Our success can only come from persistent effort intelligently directed. If we are not receiving the returns from our dairies which we think we ought to, we must find out the reason. Why does neighbor A receive a check each month one-half larger than mine, or perhaps neighbor B's is twice as large? Why? Do not let us make excuses. Let us find out — why? It cannot be that A's cows eat one-half more than mine or that B's eat twice as much, for their farms do not produce one-half more, or twice as much, as mine. Then, can it be that A and B understand their business better than I do, and that they have better cows for dairy purposes than I have. There is certainly nothing to prevent my reading just as good dairy papers and books as my neighbor or getting his advice about things he can do better than I. I am willing to work just as hard as he does and I want just as good wages. Any dairyman can subscribe to this declaration. If anything I can say to-day may help such a dairyman to realize his wish, I shall be pleased indeed. Our success does not come by pushing others down, but we are more successful by helping others to succeed. To be successful we must have faith in our business, believing that every intelligent effort will be rewarded. Others are successful; we will be. Then we must have cows to work with, adapted to our locality and to the purposes for which we keep our dairy. We must have faith in the breed and in our own cows, based on an intelligent judgment. I do not care to advise as to the breed for there are extra good cows in every dairy breed, but you must do your best to get as near the top as it is possible. Do not think that I am advising you to breed only thoroughbred stock; I am not. But I do believe that to be successful you must stick to some direct line of breeding. Uniformity in your cattle will appeal more to your pride and ambition and, besides, constantly changing by crossing first with one breed and then with another is altogether too risky and is less likely to give superior results. Nearly every dairy must be kept up by raising the cows on the farm. You have a dairy already, no doubt, and some of the cows are much larger producers than others. Breed only from your best cows. No matter if a poor producing cow is as handsome as a picture and her calf promises to be equally so, do not raise it. There are two old sayings to keep ever in mind: 'Handsome is as handsome does,' and 'Like begets like.' Are you working long days on the farm putting in crops, caring for them, harvesting them and then feeding them to dairy cows that you may each morning and evening go to the stable and look at a handsome row of cows, or are you doing this work that you may receive from the cows which consume the products of your toil, such a bountiful return that the necessities and comforts of yourself and family are abundantly provided for?

"Remember that in breeding, the sire is half the herd and use one only from a large-producing dam and descended from large producers for as many generations back as possible. Then keep using those of the same breed, thoroughbreds, if possible. Now raise the calf well — yes, if you are aiming high in dairy returns, raise it extra well. Do not start more calves than you can raise extra well. Of the cows in my herd I have raised all but six. The calves are given what new milk they will drink twice a day until they are four or five weeks old, then scalded oilmeal and middlings in a thin gruel and at about bloodheat is gradually substituted. Good hay and bran or mixed feed or ground oats are kept by them until they will eat as much as is thought best for them to have. A little salt should be added to each feed or kept where the calves can help themselves. Also give them what fresh water they will drink. After the milk is taken off, whey is added to the scalded gruel and, if the calves are started in the spring, as the weather becomes warm the oilmeal and middlings are added to the whey without scalding. The oilmeal and middlings are used in equal parts at first, later, one of oilmeal and two of middlings and the quantity increased gradually until at from three to four months each calf will take a quart of the mixture at a feed twice a day. The calves may be kept in the barn and fed hay or turned out during the summer, but keep the feed up and be sure they have plenty of hay or grass. As cold weather comes on they must be put in the barn. The slop may be gradually reduced, if desired, and a little oilmeal added to the bran or other dry grain of which they should receive four or five pounds a day during the winter and will do much better if they are fed a few roots, especially when first put on dry feed. The next summer give good pasture, put in the barn in good season in the fall and begin at once to give about two pounds of grain per day until they produce calves at two years old. A heifer so raised at present prices of feed would cost $50.

"Will it pay to raise them so? They will be twice as large as the heifer you can raise to two years old for $25, and will give twice as much milk the first season. If you are so situated as to have plenty of skim milk and will provide extra fine hay and an abundance of roots, the cost for grain may be materially reduced.

"During the past three years I have sold my youngest stock off closely and have had but six heifers of my own raising come in milk. They have been raised as described above and have milked with first calf as follows: Lunde Burke in 10 months gave 7,136¼ pounds, was sick just before going to grass and did not do as well afterwards. Clothilde Artis Raphaella 2d, gave 8,421¼ pounds in 10 months, was milked three times a day for about six weeks. Rag Apple Abbekerk Burke, nearly three years old, 10,500 pounds in 10 months; Valley Farm Netherland, 8,412.5 pounds in 10 months; Jannek Bright De Kol, 8,953.6 pounds in 10 months; Valley Farm Pauline De Kol, 7,988.95 pounds in 10 months, the last two milked three times a day for an official butter test, an average for the five two-year-olds of 8,192 pounds for 10 months' milking. Does not the larger production of first season pay for the extra cost of raising the calf well? Another purpose almost as important has been accomplished: The owner is proud of such heifers, is pleased to show them to any one who may visit the stable and to tell of their yields.

"After the two important steps of selection and raising to the age of production, comes the economical maintenance of a producing dairy. The feed for our cows has been about as follows: Ensilage once a day and hay twice. Fresh cows received about 10 pounds of grain a day, which is continued with the winter milkers until the milk shrinks considerably or the cows show gain in flesh. During flush of feed but little grain is given. Gradually increased as pastures become dry and short. Sowed corn is fed during fall and until cows are turned into afterfeed. The grain has been mixed mostly two parts sprouts or bran and one of gluten meal and cotton seed meal, the proportion being varied somewhat. Occasionally some oilmeal is added. In order to know how much a cow giving a good flow of milk would eat, March 9th and 10th I weighed what was eaten by two cows fresh last September. I estimated their weight at 1,100 pounds. The grain was mixed, cotton seed, 100 pounds; gluten meal, 125 pounds; bran, 225 pounds. Each cow was given 10 pounds and, besides, consumed 25 pounds ensilage and 18 pounds hay per day. This gives 29.9 pounds of dry matter, 3.45 pounds protein, 16.57 pounds carbohydrates and fat 2¼ pounds, total digestible nutrients, 20.07 pounds and a nutritive ratio of 1. to 4.74. There is an excess of 13 per cent. in dry matter and of 15 per cent. in total digestible matter above the standard for milch cows. One of the cows averaged 35.6 pounds, the other 36.7 pounds of milk a day. The ration has given me good results. I have milked 32 cows the past year, three others for short periods, but their milk will not equal the amount fed to calves. The total amount of milk delivered at the cheese factory, and the station from March 1, 1900, to February 28, 1901, was 287,857 pounds. Net receipts, $2,701.16; an average per cow of 8,995 pounds milk and $84.41. It is the best year's work my herd has yet done. I expect to increase the average to 10,000 pounds per cow. A considerable number will give over this quantity now, and I can see no good reason why I cannot raise more to do equally well. As nearly as I can tell the cows, producing calves in the spring, are fed 1,800 to 2,000 pounds of grain during the year, and the cows fresh in the fall from 2,000 to 2,500 pounds. The average cost has been less than $20 per ton. So that the average proceeds per cow above the cost of grain is about $63."

In conclusion, Mr. Wood cited the returns from some of his best animals, one of which gave over 10,700 pounds of milk during 10 months, which brought $111.35.

Breeding Poultry Considered from a Fancier's Standpoint.

How to Produce the Best and How to Condition it.

A Paper Prepared for Cortland County Institute,

By T. F. McGrew of New York City.

The production of exhibition poultry has gained a position in the live stock world that might be called a science. Experimental work, chance shots, or the production of numbers and selecting the best from the lot, will no more give us the desired quality. Real quality must come through the ability of the handler so to pair his birds that their offspring will be better than the parent birds. Therein consists the real secret of success. It is worse than folly to hope to secure even medium quality from poor stock badly mated; it is also equally useless to look for good results from a better quality if improperly joined in matings that are unnatural and inconsistent.

It is quite impossible to gain the ability of proper handling from any other source than experience. We may add to our knowledge by study; we may improve, also increase, our experience from hearing others tell us of their methods, but the actual results can come only as the product of practice. One is just as likely to learn to guide a plow upon the parlor floor as to learn to produce high-class poultry without the actual experience of proper matings of an established line.

When I mention "actual experience of mating an established line," I wish to impress upon your minds the absolute necessity of building up your blood lines within your own yards. Many of us would fail of success if allowed to select the choicest specimens from the yards of the most successful breeders. This is no reflection upon our ability; it is simply the results that naturally follow the union of unrelated bloods, of which we have no actual knowledge. Even if we had, all the information needed as to their line breeding, we still would lack the necessary experience that comes with years of mating and rearing the progeny of these matings.

I do not believe that there is a fancier in the whole United States who can go into your poultry exhibition, if unacquainted with the fowls, and select a pair, trio or pen of Barred Rocks, from which he can produce next season the winners at any of our larger shows. It is this continual mixing up of unrelated bloods that brings to the surface so many imperfections. We hear the continual cry, " We need new blood in our yards," from those who have not bred in line even for three years. While, on the other hand, continual success comes to those who have bred their stock in line for 20 years.

It is quite usual to attribute all the ill effects of bad matings to inbreeding. You will often hear it said that size has gone, the result of inbreeding for color. While this may be the present condition of a flock of birds, it is the actual result of inbreeding poor form and inferior size; for, if form and size have equal consideration with color in your matings they are quite as apt to improve as is the color. It is quite as easy to keep size where it should be as it is to gain good color.

When we have fully learned that size is largely influenced by the female, we will begin to discard, as breeders, all females that are undersized. More attention will be given to the selecting of fine, large, vigorous females for our breeding stock. The more familiar we become with the real value of such females, the more willing will we discard or destroy the small or undersized specimens. If we absolutely set our rule against the use of small or undersized females as breeders, there will not be any danger of injury to size from line breeding properly carried on for 20 years.

At once we are prompted to ask: How shall this be properly done so as to hold the vigor? This is the result of personal knowledge as to the pedigree of your stock. The most absolute knowledge of their breeding can come only from knowing the hen that produces each individual egg, and in this way know the sire and dam of each chick produced. If your fowls are mated in pairs, and you possess three to five good hens, it provides as many families as females bred, and the interchange of the separate descendants from these hens will provide all the new blood that can be needed for many years. If such care and attention were given to their production, more fine show specimens would be produced from a dozen good hens than are now produced from flocks of a hundred.

How to Select and Manage Matings.

The real art of production begins with mating the parent birds, and right here is where the majority of our mistakes are made and our work destroyed. We may all be able to select our best birds and to know beyond the shadow of a doubt that we have our best pair mated; but this may not be a proper mating, and most usually is not. Even our very best may not be fit to unite as producers of better than themselves; for though lacking in only trivial respect, they may both lack in exactly the same respect, tending thereby to accentuate the defect in their progeny. In mating, our aim is invariably to produce better than we have, and unless we manage our matings so as to obtain our wish we are liable to severe disappointment. With all fancy stock the aim is naturally to move ahead and to improve what we have as rapidly as possible. Take away that aim and the fancy would die from want of a sufficient motive to keep it alive.

No one can positively be told how to mate for results; it is a problem which each must solve for himself and in the consideration of which so many different factors are closely entwined that it becomes a most complex problem, the solution of which must remain a matter of the future, proved by experience, not by theory. The most prominent factor is the full and complete knowledge of the blood lines at hand; in other words, of the material available for the work which it is desired to accomplish. No one who trusts to chance matings can hope to keep up with advanced breeders who keep close records of their work and who through a system of record-keeping are enabled to tell the exact value as a breeder of every one of their birds. Guided by the information gathered in years of scientific record-keeping, as well as breeding, they know just where to turn when in need of any special trait, and, leaving nothing to chance, their success is reasonably assured.

The one best or most appropriate male can form one-half the pair-mating for five hens. The proper appliances or management can fully assure us, beyond all cavil, as to the origin of the individual egg, which can be numbered, and the chick produced from same so plainly marked between the toes as to be always readily selected as the result of any former mating. Many make use of small yards and houses, all which are so joined as to make it quite convenient to shift the male from one pair of mating to another. Others use trap nests; while others have separate nest boxes, from which the hens may be taught to select one. This is a very uncertain method that carries with it almost equal distrust as that which goes with yard-matings. Guesswork is just as good as any, if right; but there cannot be any assurance of correctness that is based upon guessing the hen that laid an egg in any nest, unless she is either caught in the act or a trap.

Learn by experience gained from well-kept records which pair of fowls *have actually* produced your best; cast aside all possible chance for mistake, and when you have gained this valuable information, continue to make use of these known producers and their offspring; continue to breed from known producers only; do not waste your time, room and food on those that have demonstrated their inability to produce better than themselves. More time is lost, money expended, many good valuable specimens discarded through guesswork and lack of knowledge of their real value than would build up and carry forward a paying plant for the production of high-class show specimens.

Selecting from Thousands.

The desire for profit leads us to produce thousands for sale; it also tempts us to buy for exhibition, so we may win the honors that guide the purchaser to our yards. Of what real value is a flock of several thousand that will not turn out the winners to gain enough credit to sell their yard companions? The man who can produce a single winner in strong competition from 12 or 20 raised has shown by far more skill than is displayed by those who select a dozen winners from many hundred. We set the pace when we run wild to secure stock and eggs from a noted prize-winner. Our very determination to have some eggs from the pen he heads compels his owner to increase the number of hens in his " harem " to 10 or 12, giving us one chance in a thousand for every egg we buy.

Perhaps one or two very good hens may be placed with the most noted prize-winner to sell eggs from, but no breeder can afford to lose the use of his own best females for a whole season to supply eggs at 50 cents each, that may produce $50 or $100 birds. For these reasons, it is an absolute necessity for all to study the producing qualities of their own and learn to pair them so as to produce the best, rather than to rely upon the selection from among thousands in our own or other yards.

How to Rear Prize-Winners.

There are three propositions that govern all sides and phases of *poultry culture,* as pertaining to the actual rearing of fowls. No matter whether for the spit, egg production or show pen, these same rules must be followed. Their very simplicity counts against their proper observance and use. Of these three we have spoken so much of that we fear an early attack of the three graces.,

The first of these is good, comfortable, dry quarters for both the breeding fowls and the chicks; the second, thorough cleanliness in and about their quarters; the third, proper food and water supply. If these three rules are strictly adhered to, the successful rearing of your fowls is assured. If not, just so sure will you invite, with open arms, the failure which follows.

If mankind is foolish enough to move his family into a new, damp house for their abode, the chances are that the scourge of diphtheria will visit his home, with its usual results; the same ailments come to our fowls when compelled to live in damp, unhealthy quarters. Good, dry, comfortable quarters is an absolute necessity for success with poultry. No matter how cold it may be outside, fowls will prosper in dry, comfortable quarters without any artificial heat. A long-continued wet spell counts by far less against them, if they have a comfortable, dry place to go into when so disposed. Whether cold or warm, absolute freedom from dampness, as far as possible, must be the rule in the living quarters of both old and young fowls.

Cleanliness is an absolute necessity. This habit of an occasional house-cleaning will not do for those who hope for either pleasure or profit from their fowls. No one ever has or ever will succeed with poultry unless they keep their henhouses and surroundings in good sanitary condition. No prize-winner ever came from ill-kept pens; nor profit from the egg production of poorly-cared for or neglected hens. A broiler plant located in a damp place that is allowed to become dirty will scarcely need the assistance of an expert killer to execute the stock; they will die of murder at the hands of those who might have saved them with proper care. Why people cannot learn to keep their fowls and their surroundings in proper condition no one can tell.

Food and Water.

There is no problem connected with the rearing of poultry that will bear equal consideration with the question of: When, What and

How Much to Feed? If we admit that the laying of eggs out of the natural brooding season to be an artificial condition, we have more than natural demands to supply; and while the best methods of feeding for egg production is not a part of my subject, at the same time I will say, our high-class breeding fowls need greater attention in this line than do the market or egg producers.

Fowls kept for breeding stock should be well fed, so as to keep them in good working condition. Their diet should be composed of all kinds of grain, green food and but little soft or mixed food, as it has a tendency to make internal fat. A little mixed food each day is good, but the tendency is always to feed too much of it. Grain, seeds and bugs are the natural food for fowls, for all which it is their nature to dig and hunt. If we wish the best results, our breeding stock should be compelled to dig and hunt for all they have to eat. You simply kill them with kindness when you scatter food upon the floor or bare ground for them to eat. Make them dig in the straw and seek for all they get to eat.

Plenty of good, fresh water should be constantly before them, day and night, during all the months in which it will not freeze. During cold weather they should have water during the day, but at all times remember that an early drink of ice-cold water will shiver them the same as it would yourself on a cold, raw morning. Hot water is not good for them; neither is hot food; both or either, just a little warm of a cold day, is not bad. *Hot* food or *hot* drinks create an unnatural heat, from which they must have a reaction, both conditions very unnatural for a fowl.

Care of the Growing Chicks.

Fowls intended for exhibition stock should be fed all they can be induced to eat, within reason, from the time they are hatched until finished for the show. Don't overfeed or gorge them, but keep them so well cared for that their crops and gizzards are never empty. And at the same time have present a lack of fullness of crop that will induce them to hunt continually for bugs and seeds. The continual exercise is of great value to them. A poorly-fed chick will never make an exhibition fowl of merit.

The Exhibition Fowl.

The proper handling of our stock is beyond all other conditions. Allow me to explain my meaning by citing an incident of the past season: A friend had 60 eggs, all laid by five Brown Leghorn hens. One-half of these was given to a man who thinks, at least, he knows how to rear high-class birds; the rest he kept at home. Each 30 eggs produced almost as many chicks as there were eggs. The result: On the owner's own town lot, 11 grand, fine females, one male selected, the rest all killed. Out of the 22 reared by the other man, only one female considered good enough to bring home, showing to what an extent the proper care of the growing influences quality.

One glance of the expert's eye at a flock of growing chicks will tell him of their future. Whenever you reach the position that calls forth the statement of "I cannot grow my chicks to proper size," you may depend upon it that the fault is yours. If you cannot learn to remedy the evil, better give up the fancy fowl business, for you have the proof before you that you are not a poultry man.

To Condition our Fowls.

Good health is the secret of fine condition. All the labor that you can bestow upon a fowl in poor health will not make an exhibition fowl of merit out of him. Health and vigor are the secret of success, to a large extent. Do not coop up and coddle your chicks to be show specimens. Thick underbrush, for all-day run, is by far better than to have them shut up in an improperly ventilated house. The longer they can roam at will over field and in the brush the better. Such life gives them the glow of health that imparts the rich gloss to their plumage. When the time comes that they must be penned up so as to become coop-wise, try and imitate nature as closely as possible in their care and food.

What Shall I Do?

**Delivered at the Farmers' Institute, Rhinebeck, N. Y., January 29, 1901. By Miss HELEN REED, A. B.
Rhinebeck, N. Y.**

When the invitation was extended to me to address this meeting on some subject which had especially interested me, at the close of the nineteenth century, I selected one which may not have any special reference to a meeting of this kind, but one which I trust may not be wholly out of place, and so I will present to you a few thoughts on a subject which should be of vital interest, not only to every woman present, but to every man upon whose shoulders rests the burden of the care of others.

We are living in a time of clubs, of conventions, of institutes, a time when every one is interested in some particular line of work. It may be art, philanthropy, social or domestic science, but there is one question which every woman should ponder, and not leave until she can satisfactorily answer, and that is, "If compelled to support myself, how shall I do it?"

Neither wealth nor social standing should prevent a careful consideration of this problem. The present possession of the former is no guaranty of its continuance. Accident and sickness and death invade every household, and not one of us can tell at what moment the burden may fall upon our shoulders, and no woman who respects herself, desires to become a pensioner upon the bounty or generosity of those on whom she has no claim.

Some years back the public attitude was somewhat different toward the self-supporting woman, and even, to-day, in the South especially, there still exists the feeling that a man is disgraced who will allow a woman, even though she be a most distant relative, to labor for a money compensation, outside of her home.

This attitude had two bad features. It took from a man's own family what rightly belonged to them, and it made a dependent and a pauper of the woman who could and who should have earned her own living. It made her life a burden and one long martyrdom for which marriage was the only relief, and many a woman was forced into a connection against which all the finer instincts of her nature revolted, rather than remain the recipient of a grudging hospitality.

Let me say right here, that I am not urging all women to step out into the world and assume a support which it is their privilege to receive, and, I believe, that where it is not necessary, we women can do more for the world by leaving the vacancies for those who do need them, and that by thus lowering the competition and diminishing the supply, we can increase the wages paid for the work. Neither would I lift one particle of the burden from the shoulders of those to whom it rightfully belongs, for a man never reaches his highest development until he knows what it is to have others dependent upon him for their daily bread, and from a close study of conditions existing in the factory towns in Massachusetts and Connecticut it has been shown that almost without exception, where a man's wife was working to support the family, that that man never attained to the best paying positions, and that he lost his ability to earn as the necessity for it was withdrawn.

But my plea is that every woman should be ready to take up the work that may come to her, and the increasing intensity of the struggle for life makes it our duty to study the question as to the possible and advisable lines of woman's work.

There are a few exceptional women as there are exceptional men who have no difficulty in answering this question: What shall I do? They are so eminently fitted for certain lines of work, that they cannot fail to find their proper place. But for one Maria Mitchell, one Clara Barton, one Rosa Bonheur, there are thousands of us average women, who must face the same question, and who find it infinitely harder to answer.

Some years back there were but two lines open, teaching and some form of domestic service. To-day, the profession of teaching stands first on the list, overcrowded by those to whom it is but a temporary occupation, by those who have no special aptitude for the work, but who are attracted to it because it is one of the few occupations in which a woman can labor and still maintain her social standing.

Before we try to answer that question let us see under what disadvantages we are laboring. The greatest disadvantage lies in woman herself — unwillingness to submit to the necessary training. Not long since a leading chemist offered to train a class of women as apothecaries if they would submit to an apprenticeship like men, but he received not one application. This disadvantage arises partly from our education, since from childhood we are taught to be dependent on others; consequently, when thrown on our own resources, we are utterly incompetent to compete with skilled laborers.

The other great obstacle in our way is public opinion. No woman of refinement desires to attract the attention of a community, an honor thrust upon her whenever she engages in any occupation not distinctly recognized as woman's work.

To those of you who are trying to solve this problem, I would say, first of all, take an account of stock. Examine yourselves as to your abilities, your preparation, your natural bent and inclinations, but do not make the mistake of supposing that the thing you would like to do, is what you are the best fitted to do. Many a girl feels that she is a genius out of place, that as a nurse, a worker among the poor, a physician, an artist, a sculptor, she would be a success, when she is only, after all, a very ordinary person dissatisfied with her present condition.

There is always one thing that each of us can do better than anything else, if, having found it, we have the courage of our convictions, and will put under foot the foolish pride that would consider any work outside the professions as degrading.

Let me illustrate: In one of our leading colleges was a girl, a member of an old and wealthy Southern family. Near the close of her sophomore year word came that her father had failed and that she must return home. The question immediately arose among her friends as to what she should do. Teach, of course, was the verdict, considering her abilities, her education and her social standing. "No," said she, "there is just one thing in which I know I shall succeed, and which I can do well, and that is trim hats; and that is what I am going to do."

She went back home, apprenticed herself to a skilled worker in order to learn the mechanical part of her trade, knowing well that her work to be satisfactory must show the skill of the professional, and started in business for herself. She announced her opening. People who had known her in her days of prosperity flocked to it out of sympathy and curiosity. But whatever motive led them there, the beauty of the workmanship and the merit of the productions, held them. She devoted herself to her business. She studied her flower gardens for color combinations; to her it was not a hat she was designing, but a frame for a picture, and all the knowledge and skill and training she possessed, was brought to bear upon her work. She enlarged her business until it grew into one of the largest wholesale and retail establishments in the city. For eight years she remained at her post, sent her two brothers to college, and at the end of that time, returned to her own college, and took her degree. To many she seemed to be wasting her talents and her education on hats, but she knew what she could do, and she had the courage of her convictions.

A young girl who had a very sweet voice was being urged by her friends to give up her trade as a dressmaker and give parlor concerts. "No," said she, "my father would have made a splendid farmer, but he tried to be a lawyer, and he failed; my mother loved to sew, but tried to be a teacher, and failed, and I am not going to give up the thing I can do well for something I can do only fairly well, and I feel sometimes that I would like to write on my sign, 'Mary Blank, dressmaker, by the grace of God,' for I am not ashamed of the gifts He has given me."

"I suppose I might call myself a visiting gardener," an energetic young woman in New Jersey answered, when asked about her work. "You see, nearly all the people about here have garden plots attached to their homes, although comparatively few of them keep a horse. When I was thrown on my own resources, I recognized these two facts, and, being fond of farming, determined to try working other people's gardens. I secured a horse and man and soon had as many gardens as I could manage.

"I take my gardens in rotation; that is, I break up the whole of them in the autumn; in the spring I give them the second working over; then I go back, lay them off, plant the earlier varieties of seeds; so my gardens all come together.

"One great advantage of my profession is that the pay is sure. I engage to do the work by the year for a stated sum. Before planting I consult the taste of the family as to vegetables preferred. Then my one effort is to see that the supply is at least equal to the demand, and I can safely say I seldom fail to give satisfaction."

So I would say to you, don't be ashamed or afraid to use the gift you possess. If you are fond of the care of milk and the making of butter, perfect yourself in it. Look upon your work with pride, and let your only shame be, to market an article which falls below the high standard of excellence you have put before you.

Better far a first-class buttermaker by the grace of God than a second or third-class school teacher by the grace of nobody.

Take an account of stock also as regards the conditions existing in your own town or near-by markets. If a man in Red Hook were to go in the violet business to supply the Rhinebeck market, you would justly say he was lacking in good judgment. But when many of us have to send out of town to get a first-class quality of butter simply because the supply is not equal to the demand, you would immediately say there is an opening here for somebody. It is the people who take advantage of existing conditions like that New Jersey girl, who made other people's gardens, who are the successful ones.

Business has been defined as the systematic effort to supply wants, or to create those wants if they do not already exist. It is George Eliot who says, somewhere, that the man who never had a cushion doesn't miss it; so, whenever you persuade a person that they need something to which they are not accustomed, you have helped to solve the problem. It was the desire of a woman to have a Leghorn hat that started all the great straw-hat industry in Rhode Island, and our great express companies started from just such simple beginnings.

When Samson was sent against the Philistines, the only weapon in his hands was the jawbone of an ass, yet with it he slew a thousand of the foe, and again, in answering this question, I would ask, what is in thine hand, or, in other words, what business is to-day furnishing the family support?

The majority of us may not be able to branch out in any new line of work, but there is one thing that every one of us can do. We can become so familiar with the business of husband or father that, in case of sickness or death, we can step in and take up the work where they have laid it down.

This may be a startling suggestion to many of you, but is there any reason why, if a man's health fail and he be forced to receive from the hands of others what he would willingly give himself, a lucrative business should be sacrificed and turned over to other hands when, by a careful training in business methods, it might be retained in his own family.

The American man is, as a rule, full of chivalry and devotion to his family, and often they are kept in absolute ignorance of his business affairs through his desire to spare them all unnecessary worry. Though this be done with the best of motives, it is a mistaken kindness. Nothing in this world is more pitiful than to see a woman past her first prime who has had every responsibility and business care taken from her, suddenly called upon to face this problem of self-support. We all laugh to-day at the woman who, when told at the bank that her check could not be honored because her account was overdrawn, replied that they need not worry, that she would draw another; but the laughter is of the sort that is very close to tears.

There is another class of men who maintain this same reserve, but from no special kindness of heart — merely from their fancied superiority to the members of their family, and from an inherent contempt for a woman's business faculties, forgetful of the fact that consultation may bring out some new thoughts and ideas on that subject.

Now, it is no disgrace to a man not to be endowed with a business faculty, but it is a disgrace if he fail unaided, when the advice and willing co-operation of another would have brought him success. In the home life there should be no question of the superiority of the one over the other, or who has the better mind.

When a team pulls steady and true you forget all about which is the better horse, and no man has a right to sacrifice his family to his own conceit.

Administrative ability is not exclusively a masculine qualification. The brilliant example furnished us in this country in the late Mrs. Oswald Ottendoffer, the late proprietress of the Staats-Zeitung, who assumed the management of the paper on the death of her husband, soon after it was started, and who left a fortune of $7,000,000, shows that we, too, may possess a power which only needs development.

To-day many of you men are haunted by the thought of what will my family do if I am incapacitated for work. Would it not lift some of the burden if you knew that they were familiar enough with your business to go on with it, and would not their minds, too, be relieved?

There is an accident to-night: A horse becomes unmanageable and, instead of a man able to face the world, a helpless cripple is carried to his home, and not one of you has any guaranty that that may not be your fate.

How many of you women here know enough of the work planned out on your farms for the ensuing year to go on with it intelligently? What fields are to be seeded with grass or grain, the proportion of seed to the acre, the rotation of crops followed on certain portions of your farms, where to sell your produce, and where to buy on the best possible terms? Even though you cannot do the physical labor in these days of inefficient help, you will be better served if you know how to direct.

Need the wife of the grocer be any less womanly because he has taught her to judge between first and second-quality goods, where he buys certain articles, how much of each thing is usually ordered to meet the trade demands, which articles it pays best to handle, whom to trust and whom not?

If poultry raising furnishes the family support, make poultry raising your study too. If it be violets, do not be satisfied until you know everything that can be learned about violets. If it be truck gardening, make yourself an expert in that line.

While branching out in any new line of work might bring to you unsought notoriety, taking up in this way what might be called an inherited business will bring you only the respect of the community and a certain feeling of pride in your courage and success. Your business training will protect you against imposition, and, with the knowledge of your fitness for the work, there will come a habit of self-reliance and a content that nothing else can bring. You will be indeed fortunate if you never have to face the world in this way, but I pity the woman who has to face it with no adequate preparation.

There is another reason beside necessity why you should interest yourself in something outside the run of your household duties, and that is for its effect upon your own characters. A woman's work is largely made up of little things and constant attention to petty details and economies, to the never-ending round of household duties that has a tendency to dwarf and narrow the mind, especially when for days at a time there may be no contact with the outside world, nothing to take you above the dead level of everyday life.

An interest in something outside your special duties will keep your mind active and will be an incentive to give your hours of leisure to some real purpose, and I would beg of you to-day to look this question fairly in the face, and so to fit yourself for the possibilities of life that you can look into the future without fear, secure in the knowledge of your own powers.

Why the Boy Leaves the Farm.

By Mrs. C. A. U. McCarthy.

One of the principal reasons why the boy leaves the farm is because the city wants him.

It is just such nice, honorable, willing-to-work boys as are raised upon the farm that are needed in the city.

Of course there are and must be "exceptions to all general rules;" and among the many boys raised on our numerous farms, there must be *some* beer drinkers, *some* cigarette smokers.

These are not the boys who are wanted, either in the city or country.

These are the boys whom we *must* put up with, because there is no law for getting rid of them.

We tolerate their company, hoping, almost against hope, that they will do no worse.

Many people have written upon the hardships of life in the country, especially for the women and boys. These are the writers who have either lived in the country under very unfavorable circumstances or, perhaps, they have never lived in the country or on a farm.

The hard work, chores, etc., which have given rise to these outbursts of sympathy are the very things which give our boys on the farm their independence, with regard to thinking for themselves; and their fine athletic proportions and strength; their physical as well as mental power.

Where is the boy who gets up the cows, night after night, and puts them into their stanchion or stall, who does not soon begin to calculate how to do this work in the easiest and best manner possible?

Also driving horses before wagons, as well as carriages, and riding the horses home from pasture or work, is just as improving as a lesson from the "riding school."

Many a young lad shows his discretion and judgment in loading grain or hay and driving the load down the hills, through gates and bars, landing the load at last in a good position, near the stack or in the barn.

I have seen many a grown man who came from other countries, where boys are not allowed so many privileges, gaze in open-mouthed astonishment to see a young lad doing all this — and more.

Ah! it is one of the most unfortunate things about city life that the boys have so little work adapted to their abilities after school hours. And how many we see whose parents seek a place in the country for their boys during the summer vacation.

We all have heard of the many cities and villages which have lately been obliged to adopt the "Curfew Law" to keep their boys off of the streets.

How much more pitiful this seems than that once in a great while some boy in the country, urged on by his ambition, should overwork his strength, for I am sure no father of my acquaintance has ever been anxious to overwork his boys.

On the contrary, I have known many fathers who have denied themselves, and have worked under many disadvantages in order that their sons might be kept in school.

And these sons, knowing of the sacrifice their father made, were industrious, working mornings, evenings, Saturdays and vacations. Now, why shouldn't the cities require the services of such young men as these?

Young men endowed with strong physiques, made stronger by plowing, reaping and gathering the apples from their own father's trees.

Often driving or even walking several miles on cold winter mornings to the village or district schools.

We hear about the overcrowded cities, but they are not overcrowded by our country boys; for if they are not able to earn money, or if city life and city ways do not agree with them, they can come back to the country and take up their old occupation, not having lost their strength, for that was given with the "fresh air" they have breathed and the "physical culture" they have endured from their childhood.

Ah! friends, we sometimes enjoy these God-given blessings without thinking how great and good God is to give them to us so freely. Then there remains the fact that man is a social being by nature. The building of cities and living in large communities is but the natural way of living.

The isolation of farming life, as carried on in America, with separate farms and scattered farmhouses, deprives the family, in a great degree, of its social element.

There seems to be no place where young men can congregate for an hour's social chat with each other. Even in our villages there are no reading-rooms, no libraries, nothing belonging to them as a class or society by themselves, except the ever-ready barroom or the welcoming billiard-room.

Can we say that we are doing all in our power for our boys and young men while this state of society exists in our town?

Alas! for the owners of fine houses and elegant drawing-rooms. Let them see to this for the sake of their own posterity.

Therefore, it is but natural that our boys seek employment in the city, and being mostly of honest, industrious habits, they are welcomed by employers, and if the charms of city life do not overcome these good habits, they are often promoted to positions of trust and honor.

There are many men of my own acquaintance who are now holding positions of trust in large cities, who look back to their boyhood days, spent in the country, on a farm, as the stepping stones to their present prosperity.

I will mention one family with whose name many here are familiar, viz., Mr. Marsh, who lived on the farm now occupied by Mr. Rugg, our *Grange Chaplain.*

Mr. Marsh dying, left a widow and seven boys, most of whom grew to manhood on this farm.

All these seven boys have held, and all who are living *now* hold trustworthy positions in business, and are honorable members of society.

I could mention many more were it not that I do not wish to be personal in my remarks.

I have mentioned this one instance, because there were so many boys in one family; and this brings me to another point in our subject.

Many farmers are living on small farms — farms sufficiently large to maintain their families in comfort; but as their boys grow to manhood and desire to earn money for themselves, they have no opportunity except to work for some farmer by the month, or to run in debt to buy a place of their own.

Either of these experiences is not enticing as a lookout, and it is as natural for boys to strike out for themselves as for the young birds to leave the nest.

Not many farmers are rich enough to place their sons on a farm of their own as they grow into their majority, especially if the family includes several boys. And as one and another arrive at the age when their school days are over, they turn to the busy marts of life, and, for the reasons I have mentioned, are nearly always successful.

Now that we know why the boy leaves the farm, we might try to counteract this tendency by doing all in our power to make farm life agreeable and profitable.

Let us as a community try and be sociable.

In the lack of a library, let us form reading circles, and should any of us engage the help of our neighbors' sons, let us treat them like friends and neighbors.

The real work of farm life is no more monotonous than that of a shop or a store, and while we cannot, perhaps, dress as well while at our work, yet there is no excuse for a young man not to be neat and tidy. Even the shopman must don his coat before going upon the street.

Then there is not so much risk of failure in business upon a farm.

We never (or hardly ever) hear of a farmer going into bankruptcy.

Mother earth is so bounteous that, if the soil is merely stirred, it will yield sufficient to keep the wolf from our door.

And now, with the aid of our "Farmers' Institutes," and the many fine lectures upon profitable farming, stock-raising, stock-feeding, farm-working, etc. (which the State gives us free); the experimental stations and their reports (also free for the asking), we should be able more than "to stir the soil a little."

With care and labor we can bring our farms into a good state of cultivation.

There are but few farmers who "stick to their trade" but can own and cultivate a farm by 30, while we find many laboring men in shops who always live in the company's houses, and buy on credit at the company's store.

Then, on the farm there are no strikes. No man is obliged to lie idle because his fellow-man does not choose to labor.

No man is killed or injured because he desires to work and maintain his family in comfort while the leader of the strike says he must not.

You will observe that I speak of farmers and their sons as belonging to the laboring class.

In this I think I shall be justified. And as labor is honorable, I can see no humiliation in the fact that we are obliged to labor.

Rather let us strive so to do our work that it shall be an honor to our name that we did our work well.

Our boys who go from the farm to the city expect to work.

Could we once convince them that the same amount of labor, if given in the country, would buy them a home in the country, then we shall have more than half accomplished our object of keeping them on the farm.

Once convince them that their labor is remunerative; teach them to do their work in a scientific manner, so that it will be remunerative, and farm life is so pleasant and so independent that it will soon become more enticing than any other form of labor.

George Washington, after all the many incidents of a long and interesting career, retired to his estate and was happy in his old age in superintending his own farm.

Agriculture has always been an alluring subject since the days of Abraham, the Patriarch of the Bible.

Never in the annals of our history has there been such an opening for farming life as the present — such wonderful improvement in methods; so many nice machines to do our labor; such splendid opportunities for learning — all this and much more at our agricultural colleges.

Our papers brought to our door by the "Rural Mail Delivery" makes "Old Rusticus" another being.

In fact, as we look around upon this pleasant assemblage of young farmers and note how many here assembled have grown up in our own community (young men whom I can remember as boys), we are inclined to say: The boy does not leave the farm. He is here in force to-night striving to learn the best way to do his work. Willing to learn, willing to improve, may our institute be a help to him.

As farming has progressed so rapidly during the past decade and farming tools are so much improved, may we not hope that the work of "tilling the soil" will soon be recognized as one of the most honorable, as we all know it is the most needful of our industries.

And our boys can stay on the farm in honor, comfort and prosperity.

The Farm as a Place of Business.

By John Jeannin, Jr.

Much has been said of late about the abandoned farms of the "Eastern States," and the depreciation of value of farm lands, the foreclosure of farm mortgages, that one not acquainted with the facts would naturally infer that farming, as a business, is somewhat of a failure, and that to invest money in farms or farm mortgages is risky.

Why is it thus? We have the same sunshine, the soil is not all impoverished, machinery enables the farmer to accomplish more work in one day than his grandfather did in two.

The markets are better to-day than 50 years ago. Fifty years ago, shipping farm produce 100 miles was the privilege of but a few. To-day, the farmer of New York State grows crops to be disposed of in Europe (with the aid of cold storage and rapid transit).

The fruit growers of Florida ship strawberries 2,000 miles, while the farmers of New England hold in cold storage pears and apples for months, until their products command a better price.

The dairy farmers of central New York market their milk 300 miles to New York city, getting more money for the same than if made into butter. With these and many other advantages that science and engineering have brought to us, we still hear the wail, "Farming don't pay."

Let us farmers look at this subject in a more philosophical way by asking ourselves these questions: Do we apply the same business methods and integrity to our farming operations that the successful merchant or manufacturer does to his business? Have we kept in pace with the improvements and possibilities that are so closely watched by all successful business men?

Can we blame the younger generation for leaving the farm for something that pays better?

We must remember this is a progressive age, and if we do not use progressive methods on the farm, the best element of our boys will seek success elsewhere.

Are we, as farmers, living up to our opportunities? Are our homes and surroundings what they should be? Is our table supplied with all the good things that our city cousins are so willing to buy from us? Are we not depending more on luck than on pluck?

I must admit it is very alluring to read of a boy leaving the farm without a dollar and ending at a Rockefeller or a Carnegie.

How many of our boys have left the farm with quite a few dollars, and end in the gutter — those are not mentioned.

Was it the business methods, the happy surroundings, the good living, that caused their leaving the farm?

From a financial point, does not the well-managed farm compare favorably with most mercantile or mechanical pursuits? Let us compare them:

I have in my mind's eye a skilled mechanic working in a shop in the city at $3 per day. Health being good, he will earn $850 per year, from which he pays $144.50 for rent, $550 for living expenses, and $30 for coal, leaving $126 to lay away for a rainy day (providing he has had steady work). If the shop shuts down for two months his little savings are gone. It is true he has no capital to invest, but his skill and labor is his capital, and must furnish him and his family a livelihood.

Now let us consider the merchant, with a capital of $5,000 invested in goods, after paying rent for store and clerk hire, allowing he lives as economically as the mechanic, he must make that $5,000 earn at least $1,500. To do as well as the mechanic he must use business methods, not luck.

Now to go back to the farm. By applying the skill of a mechanic, the business methods of the merchant, it must indeed be a poorly invested $5,000, that will not furnish us a better living, a better home, and as many dollars in our pockets than either of the above.

Now, a word with the boys. Boys, on you depends the future of agriculture, as well as all other pursuits. The boy who makes himself useful and has the push and honesty to gain for himself a good livelihood and the respect of a community in other branches of business can succeed as well on the farm. Do not look at farm labor as degrading or that the clerk in a store or the skilled mechanic is superior to you in intellect. I know, from personal experience, that it requires more brains to make the farm a successful place of business than it does to make a skilled mechanic.

Don't carry the idea that the world is looking for the farmer-boy to shower on him positions of trust and honor. You must first prove yourself of the proper material before the world will appreciate your efforts, and I know of no better place on earth to prove the same than on the farm. Reverses and discouragements are met with in all pursuits, and there is no place on earth that offers more opportunity for overcoming the same than does the farm. Interest yourself in the business of farming and its drudgery becomes a pleasure. Compare your privileges, comforts and enjoyments with those of the clerk or mechanic. You will find the balance in your favor.

The same principles of manhood that enable a boy to resist the temptations and allurements of city life will make him successful as well on the farm as in the city.

The day is not distant when the farms of New York State will be managed by the business farmer, who will manage the farm for its comforts, its privileges, its independence and what there is in it. It lays altogether with you boys to choose whether you will become one of those who make the farm a place of business, thus earning an independence, or swell the crowd of discontented workers of a city.

Some few months ago I met a young man on the train, on his way to Princeton, to finish his education. He had already taken a two years' course when he met with financial reverses which compelled him to go back for two years to his former vocation of chopper in the Canadian forest to obtain the money to complete his course. He did not feel degraded to acknowledge that he was a woodchopper. I parted with him, after wishing him success, with a feeling of admiration and feeling satisfied that any man with his grit and perseverance is bound to succeed.

If more of us farmers had the grit and pluck so manifested in that young man, we would hear less complaints that "farming don't pay." We would find few abandoned farms, the farm mortgage would be a safe investment, and the farm would become a profitable place of business.

Address on Butter-Making.

By G. A. Smith.
(Dairy Expert, New York Agricultural Experiment Station, Geneva, N. Y.)

The past few years have worked a wonderful change in the dairy business. Many sections, especially in the Northwest, have witnessed the growth of this line of work from nothing to an extensive business among a class of farmers who, less than 10 years ago, were raising wheat and corn and keeping but few cows. This change was brought about by the low price of wheat and corn, and the small average yield obtained per acre from growing these crops. Year after year a few of the thinking farmers began to agitate the question of the necessity of making some change in lines of work. Some of those who came from the dairy farms of the East were inclined to take up dairying. The agents of the dairy supply houses saw the opportunity and were quick to take advantage of the conditions and to push their business. The result of all this work has been the great increase in production of butter which we have seen. In most instances it has been a success, from a financial point of view with those farmers in the Northwest. They will remain in the business, and we must meet the competition in an intelligent way or be driven out. With all of this has come a wonderful improvement in dairy machinery and a much better understanding of the underlying principles of butter-making.

The farmer in the new dairy sections has been willing to accept modern ideas much more readily, and to put them in practice, than has the farmer in the old dairy sections. The result has been a much higher average standard for the butter of the Northwest than in the older sections of the East. With all these facts before us, the question to be decided is — Have we reached the point where we are willing to throw aside traditions and change our methods to the extent of conforming to the best approved plan of the up-to-date dairyman, in caring for the milk and method of manufacture? In fact, work to secure the most comprehensive knowledge possible of modern dairy practice? Very few people have any idea of the importance of the little things necessary in the successful running of a dairy, for the production of milk and the manufacture of butter and cheese from that milk. It is difficult, in very many cases, to get as good conditions as are desired, owing to surroundings which are not easily controlled. In order to overcome this as far as possible and make the business a success, there must be a better understanding between the farmer and the creameryman than there is at the present time, in most instances. While it is true, in many places, they are working together, and, where they do, they are making a success of the business, in many of the places where they are failing, it is because the farmer and the creameryman fail to see the necessity of thorough co-operation at every point to secure satisfactory results. One trouble is that when the farmer kept the milk at home and made it up himself he knew that if he succeeded he must do certain things and do them well; if he did not, there would be trouble, and he would have to stand the loss. When he came to take his milk to the creamery for another man to work up, in many cases he lost sight of the approved plan of the up-to-date dairyman in care of milk and method of manufacture. In fact, work to secure the most comprehensive knowledge possible of modern dairy practice.

One of the things we want to remember is, that the weakest link in the chain is the test of the strength of that chain. In other words, if one man neglects his business, doesn't take good care of his milk, he is going to determine the success or failure of that creamery. You may say, "Oh, I don't know about that; I hardly believe it; maybe there is a little bit of bad milk there; but when you mix it up with the rest, it isn't going to do any harm." But, let me tell you, this is just where you will get the bacteria. Now, for a few minutes, I am going to talk to you about some of the troubles that come to dairymen through bacteria.

Many farmers have strange ideas about what bacteria are. They have very peculiar ideas about milk anyway — that is, some of them. They think that if they give the milk ordinary care it is all right. Let me illustrate a little: At the station at Geneva we have been working and experimenting with milk, and we find that in our milk, taking good care of it, making the conditions reasonably good — not as good as we could, but ordinarily — in a cubic centimeter of milk, which is about a half teaspoonful, there is about 8,000 of these minute plants. Bacteria are not animals; they are very minute plants — the lowest order of vegetable life. They grow very rapidly. When they went to the creamery and took the milk as they found it — in ordinary condition — they found an average of 200,000 bacteria in half a teaspoonful of milk. A healthy cow, under normal conditions — if you can get the milk from her udder and not have it exposed to the air — is said to be practically sterile; *i. e.*, if I could take a sterilized tube and insert it into a healthy cow's udder, and draw the milk from it through that sterilized tube into a sterilized bottle, so that no air could come in contact with it, that milk would keep almost indefinitely.

The most trouble that comes to the milk is from the outside. Of course, if your cow eats leeks and turnips — some of those foods which have a strong smell — then that strong-smelling substance, in the process of digestion, is taken in by the breath and into the lungs and so taken into the circulation — you get a smell in the milk. But you don't want to confuse the smell with the great majority of troubles in the milk. When we understand that most of these troubles come from outside sources; that bacteria are dropping into the milk when exposed to the air, and, in most barns, under ordinary conditions, the air is full of them, we can readily see that the resultant product, under the most careful management later on, is sure to show the bad effects of such contamination.

I would not have you understand that all these little plants make trouble for us. If they did, the chances are that we should fail, no matter how well the work was done.

There is one of them we must have in order to make good butter and good cheese; that is the one that produces the lactic acid. You know you can't make a desirable product without it. We always get this acid when we expose the milk for a short time. The germ works in the sugar of the milk and the product is lactic acid. The other thing that we get in the milk that doesn't work on sugar, but does on the albumen and casein, is the one that makes the gas. You take a sample of butter and smell it. At first you do not detect anything special; but, as you smell a little more, you detect a flavor of stale grease. That comes from the fact that some of these germs, working on the nitrogen compounds of the milk, have affected the fat and given it that old grease smell.

When you handle your milk in a way that some of these germs get in, you must expect to have trouble with the product. It doesn't make any material difference if there are only a few of them, and when they increase with the rapidity which ordinarily takes place under those conditions, you are going to have a plenty of them; and if all the farmers taking milk to the factory have these same conditions in their milk they cannot expect to escape having a bad flavor in the butter. But I don't want to have you think for a minute that these germs are any different on your farms than they are in the creamery. They are the same kind exactly. If a creamery is filthy, as I have seen a great many of them — very little effort made to keep it clean, the drainage imperfect, all the conditions favorable to the life of these germs — and you carry your milk there in good condition, it will become infected by these germs exactly the same as on your farm. This is what I mean when I say the creameryman and the farmer must work together to obtain best results.

I saw a sample of milk the other day that illustrates this point: It was secured for experimental work, and when the experimenters commenced to work with it, it developed a disagreeable, filthy smell, showing it had been badly cared for; and when they came to follow it back they found the trouble was this: The man had been straining his milk through a cloth strainer; and, when through using it, he rinsed it with cold water and hung it on the side of the barn to dry until the next time he wanted to use it. Bacteria can only be killed by a boiling temperature — that is, the majority of them — and when you do not expose the utensils to a boiling temperature, but simply rinse them out with cold or warm water, you make the conditions favorable for the growth of them. In a temperature of 70 degrees or above they will double every 20 minutes. Under such conditions the strainer is simply loaded up with these germs, and when one puts it on his can to strain the new milk he simply washes them into the milk, and there they are in a favorable condition to grow. The next morning he puts the warm milk into the cold milk and sets them going again, and when it gets down to the place where it is to be used it is not to use. You can't do these things and expect satisfactory results. I have seen a good many people who thought they washed their milk utensils very clean, and this is the way they did it: They would take some soap and warm water and wash the pail or pan and then bring out a teakettle of boiling water and pour it into the first dish. That would be scalded well; then they would turn the water from one dish to another, and, by the time the last one was reached, the water would be barely warm, with the result that it set the germs growing nicely in that last dish; and, when they came to put milk in it, there were your germs already to grow to load it up, and the result was tainted milk.

A good many creamerymen say it is not a good thing to have the cream vat too clean; so they rinse it out with cold water and run their cream in. In that way they use a little starter from the previous day's cream to help ripen the new cream. In this way any little defect there may have been in the cream of the day before, which did not show then, is carried along and intensified day after day, until, pretty soon, when they send their butter to the market, the word comes back, "Your butter is badly off; can't get full price," and then they begin to wonder why, and they say, "We have done everything just the same as usual, haven't changed a thing." They have been carrying along these germs, loading up, loading up, until it gets to the point where it simply ruins the taste of the butter.

Just remember it is the growth of these little plants that did the work, nothing else.

When it comes to the manufacture of butter, if you ask the people in the Northwest, who are making a great success of butter-making and who have distanced us in the East, how they have managed, you will find that they have commenced with the farmers. They have got them to understand the necessity of cleanliness, and they keep their milk in good condition. That is why these people are succeeding in this business. If they use a starter they have it made from either carefully prepared skim-milk or by the use of one of the commercial starter preparations; and when they put that in the cream and have ripened it, they have developed the kind of flavor they want.

This afternoon I will show you something of the results of a starter in the making of cheese.

Last fall I went down in Chenango county, where they have been carrying on private dairying for a long time. Some of the dairymen there are making up butter for special customers, and they have made a great success of it. I scored the butter and it was uniformly very good indeed. I had a talk with them, and it appeared that these people, through the demands of their private customers, had become educated to this point of keeping everything about their dairies clean and studying the best methods of manufacture. The result was a very high standard of butter with all of them. And they were getting a good price.

The farmer, if he does these things, has the advantage of the creameryman, for he has only his individual conditions to control; and he can control them very much better than can the creameryman, with the milk of 40 or 50 diaries.

We can sum up the whole matter of making good butter and cheese in these few words: Cleanliness and careful attention to the little details. If you will mind these things you will make good butter; if you neglect any of them, you will have poor butter as a result.

QUESTIONS.

By a Member.— What is the nature of a starter?

Answer.— The nature of a starter is to get a clean culture of lactic acid germs; it don't make so much difference how you do it, if it is only a pure culture. Prof. Harding, the bacteriologist at Geneva Station, secured a culture that would produce good clean lactic acid and would not produce gas. You must get the lactic acid germ that doesn't produce gas. He took some of these germs that he had and put into a little sterilized skim-milk which had been heated to 190 degrees Fahrenheit, with hot water around it. He kept it in a closed can for an hour and a half and then cooled it down to 70 degrees, added the germ, and let it develop. The next day it was a nice clean sour — not hard; it should not be hard and crumbly; it must be a soft — just nicely thickened, and to the taste a nice clean sour. Of course, you can get the same thing by using either one of the different commercial powders and make a culture in the same way, putting the powder into the sterilized skim-milk and allowing it to develop and then taking a small quantity of that to put into your next sterilized skim-milk and carrying it along that way.

By a Member.— Do you recommend its use?

Answer.— Of a starter? I do most emphatically.

By a Member.— What is it for?

Answer.— When your wife starts her sponge to make bread she puts in yeast, doesn't she? It is on the same principle that we use the starter in the cream. If she did not use the yeast she would not have light, sweet bread; if she trusts to luck to raise the sponge she would not have very good bread, would she? You do the same thing when you set your cream — not quite as strong as that, perhaps, but it is on the same principle. When you set your cream with no starter you trust to luck to get what you want; perhaps you will get it and perhaps you won't. One thing you must remember: If you have 1,000 lactic acid plants and 1,200 gas-producing plants, the 1,200 plants are the ones that are going to carry the day. If you have more lactic acid than gas, then the lactic acid will carry the day; but, if you have more gas, you will get the after-effect in that old greasy smell. I don't think there is any one who is succeeding in making that high, fine flavor of butter every day right straight along, but who is using a starter. The market requires a uniform butter all the time; it can't be good one day and bad the next. When you put the properly prepared starter into the cream, under good conditions, it means that you will have good butter every day.

By a Member.— Do creameries generally use the Babcock test?

Answer.— Most of the creameries in New York State pay for milk on the basis of the Babcock test; not all of them, but a very large proportion.

By a Member.— How often would a new powder have to be introduced in a starter in making 700 pounds of butter a day?

Answer.— You can carry a starter three or four months, if you are careful; I have carried it five months at the station, having made my conditions perfect.

By a Member.— I have an ordinary creamery, and have a great deal of milk and cream that is brought, many days, in an all but sour condition. In such a case as that, is a starter of any use whatever?

Answer.— Why, of course, if you have so much acid in the cream when it comes that will be a starter, and you don't need any more; but I don't believe it possible to make a high-grade butter under these conditions.

By a Member.— To use a starter in that case, would the failure in quality of the butter come from the starter or from the original milk?

Answer.— In such a case the fermentation produced by the germs already there, having gone so far, it is impossible to counteract the influences they have produced.

By a Member.— Isn't it necessary to have a few bacteria in the milk?

Answer.— Certainly; have got to have them, but we don't want the wrong kind. Let me illustrate: I go into your barn, throw down some hay, stir it around and get the hay dust all over your barn; then take a gelatine plate and wave it around, I will catch some of these plants; the chances are I will catch a germ that is called the hay bacilli. These germs will make the milk putrid in a short time. Don't you see, if you have these conditions in your barn, it is almost impossible to make fine butter. When cows used to be kept in the pasture and milked in the yard, never putting them in the barn, then they had better, very much better, conditions. The stables should be kept clean. In certain sections of New York they compel the farmers to keep their barns swept down and the stables whitewashed thoroughly.

Do everything you can to make the stables as sanitary as possible; use plaster to keep down the ammonia, etc.

By a Member.— Would you advise the average dairyman to use a starter?

Answer.— Yes, sir; I should. In every case that I know where private dairymen are using a starter, they are getting a very much finer product of butter.

By a Member.— Do you consider it practical for the average creameryman not to renew his starter but once in three or four months?

Answer.— Probably not; just as soon as he gets these adverse conditions in it he must throw it away and begin all over. Any careful butter-maker can tell how often it is necessary to make a new starter.

I saw a thing the other day that I believe is going to be generally adopted in every creamery where they are making butter, and that is pasteurization. I saw a sample of pasteurized butter, and also a sample of the same man's butter made a week before, not pasteurized; the first was three days old and the latter a week old. The difference between those two samples was simply marvelous. There was a perfectly clean, nice flavor in the pasteurized butter, and in the other, there was a little of that winter flavor — barn flavor — so difficult to get rid of where you are making winter butter. Of course, if you pasteurize your milk, you must use a starter, as you have destroyed the germs, and you can't ripen your cream without it; this gives an opportunity to put in just the kind you want.

By a Member.— Will you describe the method of pasteurization that should be used by the ordinary creameryman?

Answer.— The ordinary system that is used in the State of New York is what is known as continuous pasteurization. The inside can where the milk is heated has an outside jacket with steam around it. In most cases it is a flaring copper cylinder, largest at the top, with geared fan arrangement to keep the milk working toward the top. The one we use is an improved Danish machine, and we can pasteurize 2,500 pounds of milk an hour. In ordinary creamery work, heating the milk 156 to 160 degrees Fahrenheit is the usual temperature. We have heated it at 185 degrees Fahrenheit, but there you will get a cooked taste, unless you cool very quickly after that.

By a Member.— What about the flavor of pasteurized milk?

Answer.— Milk pasteurized at 155 degrees Fahrenheit does not change the flavor materially when it is cooled immediately.

Keeping Up With the Times.

By Miss **Bertha Tuckerman**, Bridgewater, N. Y.

It is with some embarrassment that I hear the subject of this paper announced, fearing the natural inference may be that the writer is expected to furnish a living example of an up-to-date twentieth century individual, whereas a sense of shortcoming, in this respect, is more the feeling that prompts toward the choice of subject.

A reverence and love for the generation of our grandfathers, as well as the remote past that lies behind them, and a sense of our indebtedness to them, that we cannot emphasize enough, is most commendable.

There is a great revival of interest in colonial times, and much is being done to preserve the landmarks of history, and everything pertaining to industries that were once of prime necessity and have now vanished completely. All this denotes a growing feeling that the past must not be allowed to fade from sight, if we would teach the youth of the present time the stern ways in which the lessons of that time were learned, and its achievements handed on to posterity.

We cannot make a better acknowledgment of what we owe to the past than the resolve to make the present a worthy child of it.

The present hour is our time, and how best to use it, our problem. This problem is not made less simple by the fact that a wonderful age of mechanical invention has revolutionized all departments of labor, for it is in the nature of revolutions that they demand of individuals the most heroic sacrifice, that the new order of things may be made to fit into the daily living of the people. Whether we like the pace of rapid living, at which life in this country is moving on about us to-day, or not, we are in the current, some where it is strongest, others where the wave is feeblest, and least apparent, but none may escape some degree of pressure from the conditions of modern life if he would realize the fullness of living. To those who have a living to get from these times, when competition crowds the market to the wall, the problem becomes one of greatest interest and demands the best thought for its solution. The twentieth century stretches before us, full of opportunities, open to all who have the heart, brain and nerve of youth and health to offer up in unfolding its vast resources. Success is for those who feel most keenly and watch most carefully to see what the needs of the times are, and how best to supply them. I am not wise enough to suggest how the details of this problem may be worked out, for instance, in the lives of agriculturists, but I have a feeling that the secret of much of our happiness and contentment must come from the knowledge that we are in step with others who are working toward the same end, and that we are receiving help and inspiration from those among us who are most conspicuously successful.

Especially for women is the outlook brighter than ever before. Many and varied are the occupations in which she is to-day striving to do her share of the world's work and realize something of the highest possibilities of life. Not less is demanded of her powers of will and endurance in solving the complex problems of modern life, than of her grandmothers of old, who spun, wove, and accomplished such wonders of industry.

Now that the wilderness is won and made to blossom as the rose, there are numberless ways in which the work of women is needed to carry on to finer issues the theories of education, the refinements of home life, and the problems of household economies, suggesting abundant opportunity for the most intelligent exercise of body and mind. She must manage her household in the most enlightened way, and reduce to practical working order the new and scientific ideas of the age. The application of science to the various departments of housekeeping is the most important and pressing question and is only to be solved by study and experiment. That she will be equal to these demands who can doubt? The many organized efforts must bear fruits of order and harmony in the next generation, if not in this. It would be interesting if the X-rays could reveal the hidden things of the future, as they do the inner workings of material things, to apply them to the end of this century and see to what goal of undreamed-of achievement the woman movement has carried the sex.

This is such an era of new development and startling enterprises that it behooves us to be watchful of the movements in the world around us, if we would keep within hailing distance of the procession, and not be left hopelessly behind out of earshot of the leading ideas of the time. It is easy enough to be dull and commonplace to take the line of least resistance, and relax our efforts to better and brighten daily living. Not so easy is it to act upon the resolve to make a certain amount of labor yield the best results, to select and choose with wisdom the things that are worth our effort, and set our faces resolutely against senseless customs and fashions that absorb precious time and strength, which turned into more worthy channels, might add to the joy of life and wonderfully renew us for its struggles and sufferings. New lines of thought, new methods of labor, new ways of doing the daily essential tasks, are constantly being thought out by the brightest minds.

Originality of thought and action is the gift of the few, but it is a gift from these few to the many.

How much are we the losers if we fail to recognize and make our own the best thought of the present time in the many branches of literature, science, art, religion, industrialism, education, politics, agriculture, in fact, in all departments of life, especially in that department which bears most directly upon our own field of activity, and will help us to bring out the best possibilities of our surroundings. To us, whose privilege it is to live the free life of the country environed, with beauty on every hand, bathed in an atmosphere of natural purity and charm powerful enough to awaken the most slumbering religious sense, nature offers the means of life, health and happiness, if the sweat of the toiler is equal to translate these riches into food, shelter and raiment. How much more than these we are to gather depends on the tastes and habits of each one. Close study of nature in the natural sciences, botany, ornithology, or chemistry, reveals a world of beauty and divine law, that opens our eyes to see with the poet Herrick —

> "A present Godlike power
> Imprinted on each herb and flower."

It is very important to cultivate the habit of accurate observation. With it we hold a magic key, admitting us to a fairy-land of ravishing beauty, and yielding a knowledge of nature's perfection in the minutest details, that is most stimulating to the investigating faculty. Once the habit is formed there is no end to the delights and surprises that are in store for the enthusiastic student of natural history, who has learned, as John Burroughs so delightfully expresses it, "to read nature's fine print."

By keeping up with the times, I do not wish to advocate a too ready acceptance of new and improved experiments, fads, novelties, and the like. Until new things are proved a wise conservatism is safer, if we do not cease to watch for and welcome those who are to be the true leaders by force of intellectual superiority. Eternal vigilance is the price of progress as well as of success. The coming century will belong to the progressive man, and we may define him as the one whose ideas keep step with advanced thought and advanced methods, and whose work is done on scientific principles. In his character rests the destiny of America in her struggle for supremacy among the nations of the earth.

Barn Construction and Sanitation.

H. E. Cook, Denmark.

We have approached a time in animal husbandry when stable conditions must be carefully considered. Animal diseases are coming to be troublesome. Tuberculosis has agitated our minds; much of the time the scare has been unwarranted. At the same time the disease must not be ignored.

In dairy sections cows are bred for performance at the pail and not always the equivalent in constitution is bred with it.

Demand for winter milk has increased the feeding of concentrates so that cows are milked from 10 to 12 months, coupled with the reproduction, annually causes a heavy drain upon vitality. This artificial cow must have surroundings suitable to her demands.

I have come to believe that many of the so-called modern stables are not ideal.

We have talked and written much about warm stables, until farmers built solid walls — in fact, a room unfit for animal life.

Then came a rage, and it is on yet, in order to overcome this close feeling — of building large, roomy stables, giving each cow 1,000 cubic feet air space, ceilings were tight and 12 to 16 feet from the floor. The moisture could not escape, nor could an animal warm 1,000 cubic feet, producing that damp, clammy feeling so disagreeable to man or beast. Many of our city brethren who build cattle barns indexed their ability to spend money by the height of the ceiling.

Heteradox though it is, I am of the opinion that the old-fashioned stable, a lean-to on the barn, may have been as safe a place as this so-called modern box, without sunlight or ventilation. It is so easy to think that anything new is an improvement. Not always!

In my opinion this question of tuberculosis will never be solved by legislative enactment.

The cow is subject to the disease, always has been, and always will be, when conditions are favorable. If we slaughter and do not change environments, we must slaughter again. Then, why not take a common-sense view of the case and do with cows as we have done with the human family? Why is tuberculosis decreasing in man? Are we less susceptible than of yore? Probably not! We are, however, taking care to provide against damp sleeping-rooms, dress warmer, keep our feet dry, and do innumerable things, sensible and wise.

Give the cows the same chance.

The remedy seems to be three-sided — warmth, dry atmosphere, secured through perfect ventilation, and the admission of the direct rays of sunlight.

The first consideration, therefore, is size. Our authorities have given us 1,000 cubic feet for an animal. This is easily twice as large as necessary. The barns hereinafter mentioned are built giving 500 cubic feet, but it is presently my judgment that a safe rule will be the floor space only that is required for the animals and their care, with a nine-foot ceiling, and no stable, for whatever the purpose, should be higher. For small apartments I should prefer eight to eight and one-half feet. We have only the heat generated by the animals to warm this space, and of what utility is the warm air found 12 feet from the floor to this poor cow that, if well fed and groomed, will lie down two-thirds of the time.

Just what temperature is best I am unable to say. A varying temperature is unsatisfactory; that is, a stable where the outside changes are readily noticeable on the inside. Keeping a cow at 60 degrees, then at 50, again at 40 and then because her milk or beef finally reaches cold storage we give the cow a trial of it for 24 hours, always proving disastrous to the milk yield. She adjusts herself very soon to those conditions, however, and does not do her best at any time. I have formerly considered 45 degrees to 50 degrees a most satisfactory temperature for northern New York, but since being provided with a stable under control we have raised the temperature with satisfaction, finding a range of 54 degrees to 60 degrees easily maintained. Being able to hold it within such a narrow range seemed quite remarkable, considering the severely cold weather so often experienced in Lewis county.

At this high temperature one would not realize by the odor that cows or animals were near. One of our institute workers who had heard me make these statements came to our place this winter and remarked on the purity of the air. Temperature at the time 58 degrees. Said I: Mr. Taber, have I overstated it? Said he: You have not made it strong enough.

This stable, shown as fig. 2, is built of wood. I am unalterably opposed to stone or concrete stable walls, unless furrowed out and ceiled. Narrow, matched lumber, one thickness inside and outside, with a thickness of building paper and cheap boards between, providing two tight walls and an air chamber. It is also ceiled overhead. The height, nine feet; width of barn, 36 feet. Two rows of cows, heads out, are thus secured — as previously mentioned, this secures about 500 cubic feet per cow. I might add that the same lumber put on to form an air space, makes a much more satisfactory side wall than double boards placed tightly together.

We have mentioned warmth first, but probably, from a healthful standpoint, the direct sun's rays would be as important. Dr. Law gives the death-dealing effect of the sun's rays on tuberculosis germs. It is commonly known that sunlight, direct, has a magic effect in destroying many disease germs, and altogether a health-giving tonic effect to man and beast.. A careful study of cattle barns over quite a stretch of territory, shows how generally this important feature has been ignored. They are built with little or no regard to points of compass, and what is worse, perhaps, the amount of window surface is so meager that one finds it difficult to make careful observation. I am unable to explain the reason for such neglect.

By reference again to fig. 2 we see that with the southern and western exposure, the direct rays of sun come in contact with the animals from sunrise till sunset, with the exception of about two hours at midday, when the more nearly vertical rays cannot reach the opposite side. One square foot of window space to each 15 cubic feet of air space does fairly well. Radiation of heat at night is easily prevented by using a curtain, to be drawn in the morning.

Farmers, let us take this matter into our own hands and not wait until the Legislature demands this hygienic provision.

Prof. F. H. King of Wisconsin, has given the question of ventilation much attention, and to him really we are indebted for systematically working out and diffusing a system that ventilates. The tubes are always right end up and when built with tight walls do not fail constantly to provide pure air. Most ventilation proceeds from the upper part of the room because it is more easily effected therefrom. The warm, dry air which we need is found in the upper strata, the foul, damp air below. The smallest crack in the ceiling does its work faithfully in lowering the temperature, but not in taking out moisture and carbonic acid gas.

One thousand pounds of live weight throws off daily, under varying conditions, from six to eight pounds of water from skin and lungs. We are not to wonder, therefore, that closely built barns are damp where no outside ventilation is provided.

The out-take flues should be built either within the barn walls and roof and as tight as a chimney, or, if outside, an air chamber to prevent condensation. This current of air, loaded with moisture, must be kept warm enough, about 40 degrees, until it gets out doors, so that the side walls of the flues will remain dry. The size will need to provide one square foot for each six cows. I think wood the most economical and safest material for construction. Being a nonconductor of heat, condensation will not so readily take place. Build them tight. Start them near the floor, carry them to the highest point of the building and cover the top to keep out snow and rain. Provide each flue with a damper at the opening, and also an opening near the ceiling that can be opened when the stable is getting too warm.

In-take flues should be built very small, taking the air about half way between floor and ceiling on the outside, carrying it up and introducing it just under the ceiling. If these flues are built on each side of the stable, provided with dampers to regulate the inflow, as effected by temperature and wind pressure, the attendant will be in such control that a very uniform degree can be maintained.

It is also pertinent that a much more complete combustion of food takes place in an animal when supplied with pure oxygen. Charcoal cannot be produced in the presence of plenty of air, free combustion takes place and only the ash remains. It is not only a question of health that we give our cows pure air, but a matter of economy in food.

CEMENT FLOORS.

Much criticism has gone forth against cement floors, and justly so, on account of being cold and slippery. I think we have overcome these objections. From a sanitary standpoint they are ideal. The old plank floors, no matter how tight and well cleaned, are always giving off an odor from decomposing matter found below. Space forbids anything but a brief statement of the essentials.

After grading the earth to a level and thoroughly tamping, where the teams had not done it, the trenches were dug out and a foundation laid of small round stone, three to five inches in diameter, and filled in with a cheap grade of cement mixed with five parts of sand. This was thin enough to run in between the stone and form a solid foundation about five inches thick. Upon this foundation, after it had set, was placed a finishing coat one and one-half to two inches thick of American, Portland or hydraulic cement mixed with two parts of clean, coarse sand. After it has "set" nicely, take a small board float and rough the surface, that is, wherever the rough finish is required. The hangers may be troweled smooth. This roughness will depend upon the quality of sand. While only clean, sharp sand will make durable floors, if not coarse the smooth condition will prevail. We find also an absolute necessity, the thorough mixing of sand and cement before wetting — action begins as soon as water is added and mixing is then quite difficult.

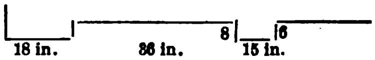
The cement is cold because it is a conductor of heat. When one touches metal or cement, he finds it cold until warmed through from the heat of the hand. Not so with wood, as a nonconductor it soon feels warm.

Without bedding, a cement floor would be objectionable, but the rough, coarse finish will hold bedding to it much better than plank. This thin sheet of bedding breaks up the easy communication between body and floor and the animals are as content as on plank.

No; do not fear a properly built cement floor. Only see to it that your mason does not put a trowel to the finishing coat on the platform and drive; of course, it may look smoother, but its true efficiency has been lessened.

Keep the surface sprinkled for a time to prevent cracking and you will have a floor as hard as stone and as tough as asphalt.

Below is a diagram of the standing platform and gutter with dimensions which we find very satisfactory:



The stable shown in fig. 1 has cows standing heads together, which permits of greater ease and economy in feeding, but what is gained is more than lost in the extra labor required in passing each side for manure and the extra width of the barn — six feet. This same barn also represents the two-story structure, while fig. 2 has all working parts on the ground floor. The only item of extra cost found in No. 2 is the roof. Frame work is much cheaper, not so much strain being brought to bear upon the timbers. Of course, the same style could be erected with very large storage above if desired. In this barn the posts are 16 feet. In both these barns, as will be observed, box stalls have been provided in the same room. No change of temperature is therefore necessary at parturition or sickness, a valuable feature to every well-ordered dairy barn. I prefer the partitions not above breast high.

For best results, water must be had inside, not only for stormy days, but the cows will drink better every day. The permanent bucket system I did not like. We therefore adopted a system that seems admirably adapted to the wants of those who do not like the buckets. A tank is placed at sufficient altitude in the barn to give force to the flow. A pipe runs above the cows, and at intervals a tangent pipe with a valve and a hose, which is taken off at will, carries the water into a light, portable trough, long enough for five cows. Two of these are used at a time, making short work of watering. The water is always pure, clean and sweet. The marked diagrams give dimensions.

These barns are not expensive, built from the standpoint of utility. Barn No. 1 has been built 13 years; barn No. 2 one year, and from a sanitary standpoint I am free to say I do not know how to improve it.

The silos in both instances are very conveniently located for feeding. Large and convenient granaries are found in both buildings. In No. 1 a windmill does service in pumping water and grinding, while in No. 2 water comes into the barn by gravity — the most satisfactory when feasible.

Home Life on the Farm.

Read by Mrs. J. R. Moses, at Bridgewater (N. Y.), Institute.

The natural advantages of life on the farm would seem to a mere looker-on to be ideal. As the traveler passes along he sees the pleasant hillsides and the fertile valleys dotted here and there with comfortable-looking farmhouses, which should always be a haven of comfort and rest to the dwellers therein.

The life of a farmer's family is one of unremitting toil, long hours of work, with little time for rest and pleasure, and often poorly repaid with the coin of the realm. If we consider the problem from the standpoint of the farmer's wife, we will find much to interest, much to improve.

In recent years many labor-saving implements have been devised for her assistance, yet the work of the housekeeper was never more complex or tiresome, and a condition is sometimes reached in which the woman's life seems bounded by the four walls of her kitchen. The solution of the problem may be far in the distant future, but it will surely come. A step toward this end will be the careful weeding out of those things that are unnecessary to health, comfort or happiniess. Instill in the minds of the young to be helpful in the little things that they can do.

Habits of order are of great assistance to the housewife; the hats and wraps, books and games are just as easily put in their place, as left where they were last used. If the living rooms are in disorder, the duty of regulating should devolve upon any member of the family who may have most spare time. What is first needed is to free ourselves from the false impression that development of the intellectual faculties alone can educate the human family. Mistresses must be trained thoroughly to understand their work in all its smallest details. It is impossible for us to direct others to do that work which we cannot do ourselves, and no other business or calling is undertaken without some careful preparation for the work to be done.

Reform must begin with the upper classes, the daughters of the wealthy must set the example and their poorer sisters will soon follow. It might be unwise for us to go back to the olden time for our models, yet the careful mother of 40 years ago taught her daughters many lessons that would be equally helpful to the girls of to-day,— not only to keep house, sew and knit, but to take care of the little things that may be needed in the future.

Much is hoped for, and has already been accomplished through the recent movement toward the study of household economics, first, by the schools in teaching the children; second, by interesting the club women of our land.

The National Household Economics Association aims to combine book culture with practical knowledge of how to live in homes worthy of us — to teach the economy of time as well as money.

Some clubs have taken up the work of giving stereopticon lectures to children, to show the contrast between neat and untidy rooms, well-kept and neglected gardens.

The study in the schools embraces the proper building of houses, plumbing, ventilation, sanitation and sewerage, and to furnish instruction in all the arts and crafts that go to decorate the home, industrial work, home nursing, household hygiene, and food values.

Mrs. Larned said in a lecture before the New Century Club of Utica, not long ago, " In Europe they are in advance of us in the matter of industrial education. No young woman is ready for marriage till she knows how to run a house — even if she is rich. They say that every young woman expected to be married, of course, therefore she must be taught to keep house and bring up children."

Many people have an unfortunate habit of worrying; this may be a matter of temperament, but it is seldom beyond our power to moderate and possibly subdue. An effective remedy is self-control, which is not learned in a day or a year, and never in a moment of excitement. It may, however, be cultivated as a gardener would watch and nourish a choice plant. Some one has said that " the martyrdom of the modern world consists of a long array of thousands of trifling annoyances." If we allow them to creep into our lives, we are soon overwhelmed with care and sorrow.

We are living too fast, attempting too much, expecting too much from ourselves and others. If life were more simple and sincere, if high thinking were made possible by plain living many of our worries would be at an end. Domestic fault finding is a relentless enemy to happiness in the family. Never ridicule or run down a member of the family in the presence of others. That reproof that is most convincing has in it most of sympathy.

A lady once got hold of a book "How to be Happy Though Married." She placed paper marks in all the pages that spoke of the duties of husbands to their wives, and placed the book in her husband's way, hoping he would be able to see his duty clearly, and correct his faults. Turning to the chapters addressed to wives he found the leaves uncut. Neither is it wise to remind the wife that she is not the housekeeper nor cook that her neighbor Mrs. So and So may be. The domestic adjuster who insists that everything must be done in the way he or she thinks best will never reform the home.

Do not forget that "an ounce of Praise in the home is worth a pound of Faultfinding."

We are often strangers at our own doors. How many throughout the farming community enjoy quiet visits with their neighbors in their own homes?

A few moments every day spent in reading from the best authors, would help us in many ways and at the end of the year the result would be surprising. It would give variety to the monotonous routine of housekeeping, and supply many pleasant thoughts to occupy the mind while busy with the hands.

Our lives are filled with care, with quiet duties, and sometimes heavy responsibilities, which we must heed and obey. Home, family and friends should never be neglected for higher education, society, or professional life. Ambition may be our most deadly foe. We need not let our talents lie idle, nor neglect to make the most of them; there is a place in the grand work for them all, and usually at home. We are often getting the most when we seem to be getting the least. The uneventful and commonplace hour is where the battle is won or lost.

Aids to Success.

Speech delivered by Martin E. Lee of Westtown, N. Y., at Unionville Institute, January 23, 1901.

The great problem of the ages and the burning question of to-day, is, "How to succeed?" Every generation of the past has been confronted by this problem, and each individual is to-day asking the same vital question. Our ideals of happiness as success may differ, but each is striving for that ideal we call success. In order to succeed in life one should early take an account of his stock in hand. For what is he naturally fitted? For what has he an aptitude? Occasionally early in life, a strong bias of mind toward some particular pursuit is manifested. It is nature's indication of a calling and should be followed. Some notable instances are on record: Benjamin West, when a child, robbing the tail of his cat of hairs to make brushes for painting, and with remarkable skill sketching with a bit of charcoal the sleeping face of his baby sister to the delight of his mother, showed what nature designed him for.

A farmer who had a fine farm of 300 acres, with nice buildings, had an only son, and he naturally desired that when the son should grow up he would follow in his footsteps and relieve him from the care and management of the farm. But the boy was in the habit of buying candy by the pound and selling it out by the stick to the little urchins of his own age who came into his mother's kitchen, and with them a great deal of mud. When he grew up his father could not interest him in farm matters, but he became a successful merchant.

So, we argue, to achieve the greatest success, a man should engage in a business for which he is adapted; in a business of which he is fond and by nature inclined, and farming is no exception to the rule. It is evident to the most careless observer that, if the farmers of the present day and the future expect to achieve any great success in their chosen calling, they must adopt or pursue different methods of agriculture from those of their ancestors. We all know that our forefathers were the founders and homemakers of this great United States of North America. They found here a virgin soil, rich in its pristine elements of fertility, which gave to them its strength or the accumulated fertility of the past ages, and as a consequence they have left to us a heritage of exhausted lands, the result of overcropping or mismanagement. It is so in the East to-day, and in course of time will be so in the West; he must restore the lost fertility of his fields and bring them back as near as possible to their original condition; he must feed his land, in order that it may feed him.

This skinning process is in vogue on too many farms to-day. I have known farmers to raise three crops on their land, seeding down with the last and failing to secure a catch of seed, allow the land to remain idle for a year or two and then repeat the process without any fertilizers. The care and application of the fertilizers made upon the farm is one of the important things necessary to success. No farmer is alive to his best interest who allows a dark-colored liquid to flow out of his barnyard, to be washed away by the rains; we must strive to make two blades of grass grow where one grew before.

Here in Orange county the dairy is the principal source of the farmer's income, and on too many farms the only source. We believe that by weeding out the nonpaying cows, by judicious care in breeding and selecting his dairy a farmer can add $10 to $15 net receipts per cow. On a herd of thirty cows, it would make $300 or $400 per year, the difference between success and failure in farming. We believe we should practice a more diversified farming, not put our eggs all in one basket, so to speak, but cast around for every possible means of swelling the income. Every farmer should keep enough hens to buy his groceries. One of the greatest troubles with farmers is, they do not depend sufficiently upon their own farms for subsistence; they have an idea that they can buy many things cheaper than they can raise them. This is well, if they raise something a great deal more profitable and make the exchange.

The successful farmer will apply business to farming; he will keep an account of his receipts and expenses. There is a mine of truth in those words of John Randolph, when he said: "Mr. Speaker, I have found the philosopher's stone; it is, 'Pay as you go.'" Success in farming depends upon the farmer himself more than anything else, upon his industry, frugality, tact and judgment, or, in other words, his methods; he must be a good buyer and a good seller, a director of labor — in short, a business man. The Farm Journal says that the door of success has "Push" on it, and we believe that the same amount of intelligence, effort, tact and good judgment that is necessary to work a success in other branches of business, if applied to farming, will bring the desired results.

We have reached an epoch in our history when every branch of industry in our country is organized for mutual protection, save that of agriculture. The result is patent to all. Seven millions of farmers live beneath the stars and stripes. Complete union, organization and co-operation on the part of these farmers would make them the most independent and powerful people of our great National Union. Then, again, we can be materially assisted by proper legislation. Three-fourths of the counties of our State have agriculture as their predominating interest, yet for years, the lawyers, the doctors and the saloon-keepers have been almost the exclusive lawmakers. Probably not more than one-tenth of our legislators are farmers. Now, the farmer ought to have enough politics in his make-up to look out for himself.

Farmers, the absorbing theme is this: Have the last 50 years proved advancement in agricultural lines as in other branches of industry? Have we kept up with the band wagon? Are we, with the noblest calling on earth, keeping step with the upward and onward march of the age in which we live? We have made progress, it is true; but the vital demand to-day is for better farmers, nicer farms, purer stables, cleaner milk, better butter, more attractive homes and sweeter firesides. Let us rise to a higher appreciation of our calling. Let us compel more of the head and less of the hands to accomplish our mission. Let us then enter every open door that leads to a better education, a better comprehension of the duties of our arduous calling. Let us tell our boys and girls that the highest physical development, the purest society, the most enlightened citizenship still lingers in country life. In the town in which we reside there are homesteads which have been handed down from father to son for over a century, and our love and reverence for them is something akin to that which Hawthorne had for old Salem as he expresses it in the "Scarlet Letter." He says: "It is now two centuries and a quarter since the original Briton bearing my name first came to this town, and here his descendants have been born, have lived and died, and have mixed their earthly substance with the soil until no small portion of it must necessarily be akin to this mortal frame wherewith for a little time I walk these streets;" or, in other words, he means to say that for 225 years so many of his ancestors have been born and lived and died in old Salem that the soil of the town was like his own body. Then let us hold fast and hope for better days. Occasionally we catch glimpses of the sunshine, the advance guard of prosperity.

Social Life on the Farm.

A paper read by Mrs. J. E. Middaugh of Belmont, N. Y., at the Cuba Institute.

It is better to be born lucky than rich; then you will likely be both. To know how to enjoy life, to rejoice and be glad, is a well-spring of pleasure and nature's own riches. Happy people are, I think, like poets, born, not made. If you are one of these happily-constituted people there is plenty to see and to do, and even a country neighborhood is never dull. If there is a wedding, you think the bride looks lovely, and you hope she will see her golden wedding. If a man dies, you stand with his children around his grave and hear with them the thud of the first earth on his coffin. If a child is born, you say pleasant things. With the school children you go out in the lovely fields, set tables under the trees and have a picnic. In a grassy nook in the forest you build a fire and cook a gipsy dinner to the delight of your guests from town. They also enjoy a visit to the maple-sugar camp in the spring. You keep Arbor Day and pass a subscription on which men sign the number of trees they will bring and set out on the school grounds, and you soon have a grove of young elms and maples. "A thing of beauty is a joy forever;" and children will play in their shade and birds sing in their branches.

You see horses that have plowed many fields and drawn many heavy loads, gentle and patient workers, kind and faithful servants, eventually the slaves of cruel men. You enlist the children and form a band of mercy. You hear a neighbor woman is very ill. You sit by her bed in the silent night and, although she talks with you, you know she will soon cross the dark river. You meet the children Sunday morning and recite with them "Though I walk through the valley of the shadow of death I will fear no evil." You get up a drama with recitations and music and have a school exhibition. You see poor Fatima with the stolen keys, at the feet of Bluebeard, and have a tableau party. One evening in the week you read history and biography, discuss questions and have a lyceum. The questions are not all political. The children help you decide if the crow ought to be killed for pulling up the corn, or if he does more good than harm in his long life, and really is he, in some countries, called a vulture. And the skunk — ought he to have a chance to live, he eats so many worms that would injure grain and orchards — but he eats the eggs of the ground birds and they, too, eat worms, if they can live. And once a year you go to the fair, the county fair. Is that *passé* and always the same? To us, perhaps, but how new and wonderful to the children, and they should all go, there is so much to see and learn. One boy notices the machines, and how they differ from those at home; one the cattle and sheep and the paintings, the beautiful pictures; while the little girl likes the grandstand, because she is interested in horses and still more in people. It is new and interesting to them and is part of their education, and you will never begrudge the time or the money years after, when you look back. And you go to the circus with its trained animals — seen in one brief day — but talked about for weeks and months and perhaps years after by the children and their mother. Not to see it seems like defrauding them of pleasure they might have had. There may be evil in a circus, but children will not notice it much if their fathers and mothers are with them, and call their attention to the good and not the bad.

You have Christmas trees, where every child in the neighborhood has something; and Thanksgiving dinners, when the children come home and you invite old friends and new. "You are the first one who ever invited me to Thanksgiving dinner and asked me to bring all the children," says a lady, "and I was so glad. I would rather stay at home with them than come without them."

A good many years ago three children were burned to death in a home in Elmira, while their father and mother were gone to a dance. The next morning they were looking for their bones in the ashes, and the husband said to the wife: "If you had stayed at home and taken care of your children they would not have been burned up;" and the wife replied: "If you would have stayed at home with me I should not have wanted to go." Many interests in a community are great, but greatest of all are the children, for on them the future of the world depends. They care for your sympathy and your company, now, while they are young, but if they do not have it, and get other friends, later they do not care. Do not worry them with fault finding or needless commands; troubles will come soon enough, which you cannot help them bear. The gulf of absence will open between you.

"And now the honest farmer packs his apples up for town,
And this is the way they look on top,

O O O O O O
O O O O O O
O O O O O O

And this way further down."

o o o o o o
o o o o o o
o o o o o o
o o o o o o

There is never an effect without a cause, and why is the farmer caricatured in the newspaper? On the stage he is "Uncle Josh." Is it not because the unwritten laws of courtesy he often refuses to learn? Rivalry is not considered a high motive, but, to raise a heavy weight, we must have some kind of a lever.

You may have all heard the story of the two rival farmers. When one built a fine barn the other built a finer. When one got a nice herd of cattle the other got one nicer and more expensive. It went on in this way until one of them got in the cemetery and the other rode past and saw his monument, on which was inscribed, "Snug as a bug in a rug." He ordered a monument for himself, taller and nicer every way, and on it had inscribed, "Snugger than the other bugger."

To make your home nicer than your neighbor's is not a high ambition, but it helps a community and increases the value of real estate, and we should not be discouraged. Rural society is better than it was. People do not display their grief as much. A funeral is no longer "a howling success," even in the back neighborhoods. You need not be the slave of the woman who wants to borrow flour and sugar and oat meal and coffee and eggs and the flatirons all the same day. Or the woman who visits you twice a week (on her own invitation) and stays to dinner and supper, and then goes and tells all the wide world, who will listen to her, everything that is said and done in your house. The sacredness of home is nothing to her. The husband may make or mar the outside fortunes of a family, but the social standing generally depends on the wife. It is her prerogative to invite the guests and this right should never be invaded.

It has been said the negro of the South will never be a better man until he has a better mother. The farmer's wives must become civilized and enlightened if they would bring their families to a higher plane. "The fault is in ourselves, not in our stars, dear Brutus," and life on the farm, like life anywhere, is mostly what we make it.

Heredity.

An address before the Stockbridge Institute, by Mrs. Libbie McGuinness of Munnsville.

I read an article recently, from the pen of a bright woman, in which she said that, if she could have the best wish of her heart granted by a kind Heaven, it would be that she might have her choice of ancestors.

Well, we cannot have that. We cannot "go back of the returns," but must stand as we are elected.

Our forefathers and foremothers are facts, and we must take what we have inherited from them, with the best grace we may. Let us hope that, in some cases, it will be a fighting grace.

But the subject is one which every one will do well to think upon, especially those who have children, and the young people themselves.

Heredity is a well-established fact in the animal kingdom. Farmers and stockmen are quick to note and take advantage of its laws, and to act with good sense and judgment in regard to the inheritance of qualities in their herds.

The intelligent farmer will gravely warn his son of the danger of introducing certain families or strains among his animals, and affirm that form, disposition, and qualities are hereditary, and that he should carefully study the subject of heredity, and act according to its laws, if he wishes the best success; but, when it comes to the young man's choice of a wife, too often the father's first question will not be, "What will she inherit in the mental, moral, and physical line?" but, "What will be her inheritance in bonds, stocks, lands, mortgages, or ready money?"

To be sure, the bequest of wealth may denote honest thrift on the ancestor's part, and then, again, it may not; and it is generally said that the money acquired by meanness, fraud, and avarice, is more often a curse than a blessing to the heir.

The best thing a child can have is a noble, good father and mother; and the next best, I take it, to be good grandparents; and if, for generations back, there have been virtue, honor, goodness, industry and intelligence, has not that child a good prospect of a grand inheritance?

I once heard a woman say impatiently to a petulant child, "Oh, you're just like your grandfather" (on the father's side, of course), and who could blame the pert little miss for replying, "Well, who's to blame for my having such a grandfather? I guess I'm not; I didn't pick him out!" Of course, she was not to blame, and she felt dimly the injustice of the reproof. Her mother might have felt that her own choice of a husband threw the moral responsibility for the child's nature partly upon herself.

Every generation has a direct influence on three generations, their own, their children, and their grandchildren.

The old adage, "Like father, like son," has an extended meaning. It is now said that traits of character are more often reproduced in the third generation, so the saying may read, "Like grandparents, like grandchildren."

People naturally train their children as they were trained. Their children grow used to such an atmosphere. Their hereditary nature grows into form according to their habit of life. I often think a child's nature is, at first, like some of their bones, in a cartilaginous state, which in time becomes bone. Their natural tendencies, good or otherwise, harden into the principles of their life, and so much depends on whether they are developed rightly, left to grow wrongly or distorted by unwise pressure. It is the old question: Which is stronger, Nature or Education? But let me ask the question: Which is the most likely to produce a noble specimen of manhood or womanhood, one where education has a constant struggle against nature with a possible chance of failure after all; or, one where nature and education are in sympathy and work together?

Oliver Wendell Holmes showed his belief in the laws of heredity, when he replied to the question, "When should the education of a child begin?" by saying, "Two hundred years before he is born."

A young lady once said, when remonstrated with in regard to the questionable character of her lover's family, that "she cared a great deal more where a young man was going to, than where he came from;" but it sometimes makes a deal of difference how the family line is "headed."

But, says one, "I do not believe in heredity. Look at the lives of some who were of disreputable origin, surrounded with evil influences, yet see what noble characters they have built up; far better than many who have had the most favorable environments."

That is true; but from some far-off ancestor may have come the very noble qualities that saved him. As Mrs. Whitney says: "We do not always know just where our ties and braces are." It is often said that no one is wholly bad, and we have as good a chance to inherit the good qualities as the bad ones.

The Bible speaks of the sins of the fathers being visited on the children, even to the third and fourth generation.

That used to seem to me a bitter, cruel judgment on the children. Now I do not look on it as a judgment, but as a consequence, based on the law of heredity.

I cannot believe that we inherit *direct* evil, but we may, and do, inherit natures susceptible in a marked degree to certain good or evil influences. I cannot say that I believe a boy inherits drunkenness, but he can inherit a social nature, a weak will, small conscientiousness and a nervous organization that renders him an easy victim to drink, as his father may have been before him. And what a struggle he has before him if he conquers; as he can and should.

We all pity the man with a weak, shallow, vain, heartless, shiftless wife, or the woman with a coarse, brutal, selfish husband; but may God pity the children of such, for He only knows how they have been robbed of their birthright; the heaven-born right of innocent childhood to such sweet, pure, noble influences as shall fit them for the higher life.

I ought to believe in heredity; my grandparents on the maternal side were cousins. Among the prominent family traits were impulsiveness, plain speaking, and a keen sense of the ludicrous. Don't I know how hard it has been all my life to think a thing strongly, and not say it, and of the times when I have been overcome with a sense of the ludicrous, even amid the gravest surroundings, and probably shocked many staid, sober people, perhaps by laughing in meeting. Of course, they blamed me, never realizing that I was the victim of the concentrated natures of my ancestors; but, as Henry Ward Beecher once said, they wouldn't have censured me so much for what I said or did, if they had known what a deal I kept back.

Well, I don't lay all my foolishness to my poor grandparents. They probably never anticipated such results; but this subject is one in which every parent, every young man or woman, old enough to think understandingly, should take a serious interest.

I do not believe there is a right-minded young man or woman, who does not sometimes think of the time when little children shall come to them as Heaven's blessing. That is nature's plan of life and love. It is your solemn duty to think upon what so much of your future happiness, as well as that of others, depends. If you have "weak streaks" in your nature, do not choose a life companion with the same failings.

We say of vicious people, "It runs in the family," but do not let it run in your family, and do not marry one of feeble intellect. Feeble-mindedness is almost certain to be handed down to some one.

One cannot blame a foolish person so much for wishing to marry a bright one, but I do blame a bright man or woman for marrying a fool. I once had a pupil, a pretty young girl, who came of a family which was, for generations, with now and then an exception, noted as being below the average in intellect. I well remember working faithfully for weeks to teach her some simple mathematical principles, yet I never succeeded. I have since heard that she married and was the mother of several children, all of whom were below the average in mentality. Ask yourselves, when about to make a choice of a companionship for life, what will their mental, moral and physical inheritance be?

And may your children's children rise up and call you blessed, as the possessor of intelligent judgment and good common sense in your selection of their ancestors.

Home Life on the Farm.

Miss Maggie S. Keeler, Grooms, N. Y.

Thus far during our Institute we have been very pleasantly and profitably entertained by discussing business methods, financial questions of intense importance, and the science of farming as it has been worked and studied with all the implements of intellectual husbandry.

But let us for a short time lay aside the mercenary problems with which we have been wrestling and consider some of the deeper things of life. While we esteem money one of the choicest blessings that can be entrusted to our care, yet it is not the fundamental or essential factor of that rare gift — true happiness.

We will most cheerfully yield to our city neighbor, all honor and credit due for her halls of learning, her commercial supremacy, and her social prestige.

But the home life on the farm has its melody and mirth. The poet says: " The woods, and winds, and waters sing to us."

It has those loftier helps which only nature can impart, those softer influences which speak to us through every flower and tree and sparkling brook and forest bold. They seem to say, " God is in me." They tell us that a large per cent. of our eminent men and women come from the farm. I sometimes wonder that the ratio is not even greater, when we consider the environments of the youth on the farm. " All nature is his heritage."

Turn backward in your memories with me for two centuries or more and we will look over the history of this proud land of ours. The past is useful to us for the lessons it has taught.

When our Pilgrim Fathers landed on the bleak New-England shore they reared for themselves homes, sheltered by those rugged hills, and brightened by freedom's skies. As we search a little farther and look inside their modest dwellings, there may be seen the matron seated at the spinning wheel. And in the homes of the early settlers of New York, the Dutch, we take a shy glance at the maiden scrubbing her floors until they are of silvery whiteness; burnishing the brass knocker in readiness for her favorite gallant. The evenings were usually spent at home. The father sitting by the open fireplace giving counsel and advice, or the family listening to mother as she reads from the open Bible, teaching them the way of truth.

The lives of our primitive American boys and girls were nurtured and developed in the home. And there came forth from those homes, men and women with strong characters, with a burning zeal for liberty, a patriotism unlimited. Men who framed the Declaration of Independence and wrote the Constitution of these United States.

And though the women could not don the breast-plate and the helmet, nor wield the sword, they strove not to be great, but good. And to the battlefield they went, with aid and love, and tenderest sympathy. Others remained at home, and worked and prayed until the victory was ours. America was free.

Note then the premium which must be put upon the influence exerted in the home.

But time has changed these scenes. "All is changing except the laws fixed by the wisdom of God."

And while the home life of to-day is vastly different from the home life of 200 years ago, yet the home influence remains the same. The spinning wheel has been removed from the corner, the loom is missing from the shed. The open fireplace is closed. Inventive genius has given to the housewife much to beautify her home and lighten her labors.

In these latter days there has been handed down to us many helpful organizations outside the home to broaden and gladden our lives. The public school system of to-day is more nearly perfect than ever before. The Sunday school which it is our privilege to enjoy has been with us a little more than a hundred years. All the societies of church and State and business are worthy of the highest words of praise; however valuable they may be, they can never take the place of home. Home memories cleave to us, go where we will. And mother's teachings come to us with vernal freshness, both in the sunlight and in the shadows of our lives. They are with us in moments of evil like a guardian angel.

But our ambition is advancement. Hence the question: What of the home life of the farmer to-day? Does happiness and contentment reign supreme? I do not wish to assume that I am speaking to a discontented assemblage; but quite the opposite. Yet we frequently hear some good husbandman say, "This is the last year of farming for me. I am thoroughly discouraged. Farming don't pay."

Then the faithful housewife will say: "Yes, we will leave the farm and move to the city."

If you heard a company of professional men telling each other of their disappointments and trials, their hardships and privations, you would consider them as unsuccessful men.

Did Washington pause during the gloomy winter at Valley Forge to tell the people that he was discouraged?

Did Lincoln and Grant, while the dark days of the Rebellion hung over our land tell Congress how disheartened they were?

Did Frances Willard, in her labors of love, ever say to the world that giving her life for the temperance cause didn't pay?

Then farmers' wives and daughters, why not be contented and enthusiastic in our work? When we come to think of it, the most successful people in every line owe their success to their enthusiasm.

Do not tell the kind husband at supper time what a busy day you have had; how weary you are of the farm life; instead of this, tell him how much you love your home. How glad that the lines have fallen to you in such pleasant places. Kindle an enthusiasm in the children to beautify the home. The neatly mowed lawn, the bright flowers may be entrusted to the care of the children.

Then again we have heard the expression, "The country is indeed beautiful, but the farmer does not have time to enjoy it. Farming is all work." Would you be content with the trifles which fill up an idle life? Or would you seek mere pleasure? Work is no obstacle nor hindrance, but rather a source of strength. Very little is accomplished without work. When all the daily demands are met with sunshine in the heart, they are transformed into pleasures. But farm life should not be all work. The evenings spent in the homes of our farmers are full of delight. We most frequently find the whole family together. This is quite in contrast to the city home, where the young people hardly know what home life is. To some, home is a place where they eat their meals and sleep; but there are so many attractions, such gay festivities, club life, with its fascination, that to remain at home two evenings of the week would be almost a punishment.

In the country we find an abundance of social meetings which all should enjoy; still the evenings at home should be the brightest and best. Mothers, do not leave the churning or the ironing for the evening's occupation. Fathers, do not lie on the couch, sleeping the precious moments away. All are home. What satisfaction in those words. There are fathers and mothers who would give of their hoarded dollars, could they once more repeat those words. All are home. Then make it congenial for the young people. Get acquainted one with another. Talk over their plans. Tell them of your experiences. Give them of your merriest laugh, your noblest thoughts, and your kindest words. Sing with them, read with them, and play games with them. You will gain their confidence and their respect. Few other business men have the privilege of spending so much time with their families as the farmers.

Home-makers, bring into your household affairs all the order and system at your command. Many a housekeeper would maintain her cheerful disposition and accomplish more for her household if she were more methodical in the arrangement of every detail of her work. Give every member of the family her work to do. Even the small children love to know that they are little helpers. With a little tact on mother's part, the duties required of them will be pleasures rather than burdens.

Let each day of the week have its allotted work, and accomplish it. Do not leave everything for Saturday and make the day one of confusion and disorder; and Sunday morning will find you too tired to attend church and enjoy the blessings of the Holy Day.

Beautify your home with flowers, music and good books. Make it as attractive as your means will permit, but never go beyond your means, for if you do you will only succeed in making life a burden instead of a joy.

We claim that the farm is the ideal place for the development of the children. It is away from the many temptations found in the city. Farm life is conducive to health, and he that has *that* has need to ask for little more.

My friends, when the children have grown to manhood and womanhood, do not influence them unduly to remain on the farm. If they leave the farm, let it not be because they dislike it, but because they have strong qualifications for some other vocation in life.

I have already alluded to the fact that the farm homes are famous for producing teachers and poets, soldiers and statesmen. I will not say to the young people present this evening, that the farm is the only place where they will find happiness. Rather I would say to them, do that work which you can do well and which you love to do.

All may not have such revelations as did Joan of Arc. But all may know their possibilities and their powers.

Permit me to add another thought which contributes much more to the welfare of the home than anything I have told you. Have you invited Christ into your home? Amid all your plans, have you remembered Him, the Saviour of mankind?

O happy Home Life!
Have I called her beautiful?
Have I boasted of her grandeur?
She is a type of Heaven.

But death will enter these loved homes of ours and bear our joys away. The perfect home is found in Heaven.

Alfalfa in New York.

By **F. E. Dawley**, Fayetteville, N. Y.

During the past two years more than a passing interest has been found in alfalfa, at Institutes in parts of New York State where it is unknown. Many questions have been asked, and instructors who have seen the crop growing in the West or at the State Experiment Station, and on my farm at Fayetteville, have been able to give facts from what they have seen as well as from bulletins from the experiment Stations.

I have received many letters regarding the plant, asking where seed could be obtained, its feeding value, &c., &c. Many people have an idea that it is a poor food. A farmer at Mohawk writes: "Why do you continue to boom alfalfa? You seem sound on many questions, and are doing so much good with the Institutes since you have made them more practical than before, that you and the State behind you will do great damage to the farmers if you persist in pushing this miserable weed forward. It is as hard as sweet clover to eradicate, and no better for cattle food. See what a Western (Colorado) paper says about it in the inclosed clipping. It may do where nothing but salt bush will grow, and where the cattle must eat it or die."

Here is the clipping:

"Do not think, by the way, that alfalfa is an arid plant, growing out on the plains without water or culture. It is sown as clover is sown, irrigated as wheat is irrigated and harvested like any other hay, so that its production and use for dairy and stock-feeding purposes are strictly farm operations.

"Stock feeding is in its infancy, but the past is suggestive of great possibilities for the future. The same is true of dairying. We do not yet produce more than half the butter we consume."

I infer that my friend in Mohawk has tried alfalfa, and feels that he has failed with it. I presume he sowed too little seed, or sowed it with some other crop and the seeding was too thin on the ground. (I've been through this and am judging his experience by his results). This gave him a strong rank growth of coarse hard stalked alfalfa which was not palatable for the animals and of course they did not eat it well. Only a few years ago, I purchased just such alfalfa as this at from three to four dollars a ton and fed it to cows, after running it through a shredder. Heavy seeding and a thick stand, with early cutting, remedies this difficulty. It is hard to "get rid of" in the fields. So is white clover and timothy. It roots very deeply, and the root is strong, and it takes a sharp plow point to cut it off. But those who are growing it here are not anxious to get rid of it. At an Institute held at Fayetteville some years ago, this same question of how to break up an alfalfa meadow was brought up by a conductor, and a fine old gentleman of Celtic ancestry answered in Yankee style, by asking "'Phy the devil wod ye want to break up a meady that is givin ye five to sivin toons av good hay ach year."

His reply seemed to express the sentiment of the growers present.

Our friend seems to think that alfalfa needs irrigation to make a fair crop. Water does help it. Three years ago I cut an average of more than five tons of cured hay in four good cuttings on a small piece that had been down 14 years; my father cut a larger quantity to the acre that same year. The past summer has been the driest one I remember. The average yield of alfalfa on our place this year was not less than three tons per acre, in three cuttings. I would have been glad of an opportunity to irrigate, but as my Celtic friend above alluded to remarked: "It was so dhry here that it was a sin for ony man on the hill to dhrink wather." I believe the average yield of all the alfalfa in this section in 1900 was not less than three tons per acre, and our people are all anxious for more. A few years ago I bought good alfalfa hay for $4 per ton; to-day I can buy red clover hay for less than alfalfa; the people have learned its value as a cattle food. It may please some of those who are worrying about the condition of the eastern farmer to know that within two miles of my home is a man who last spring bought a farm for $61 per acre, running in debt for five-sixths of the purchase price, and that he has already (Jan. 1st) sold from the alfalfa fields on this farm enough hay to more than half pay for each acre on which the hay grew. This is not an exceptional case this year, with alfalfa hay worth $12 per ton.

Alfalfa is good for any animal that will eat it, although I do not advise too much of it for horses. With rye straw, oat straw, and grain, an ideal ration can be compounded. Hogs and sheep both relish it, and for milch cows and young cattle it is an ideal food.

Just compare the analysis of alfalfa hay, air dried, with that of clover and see if it is not better than sage brush:

	Water.	Protein.	Fat.	Nitrogen free-extract.	Fiber.	Ash.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Alfalfa, 1st cutting (early bud) ..	7.17	15.12	1.24	30.98	34.73	10.79
Alfalfa, 2d cutting (early flower)	7.49	17.06	1.66	36.17	26.28	11.32
Alfalfa, 3d cutting (late flower)..	8.14	15.88	1.09	34.63	28.84	11.32
Red clover, medium (in bloom)..	20.9	11.5	3.3	33.0	24.7	6.6

Or go into my stables, and with scales and Babcock test ask the cows, as I have done, and the answer will convince you, as it has me. A few years ago I made the statement in an Institute in New Jersey that if I was obliged to discard either corn and the silo, or alfalfa, and still keep a dairy, I would bid good bye to the silo, and try alfalfa, with mangolds for succulent food. Some very bright men in that State thought I was straining a point to prove my statements, or that my judgment was not good. To-day alfalfa has no more strenuous advocate in the East than Dr. Voorhees of the New Jersey State Experiment Station and any Jersey dairyman who will follow him in his practical work with the State farm dairy will be a winner.

Why do I like alfalfa better than corn? Just because I can grow more pounds of food on an acre. At the Colorado Station they compared the food values of the yield of an acre of dent corn, with those of an acre of alfalfa that had been down three years; the corn crop was a fair one, equaling 14 tons of green forage per acre. The alfalfa was cut three times, yielding 4,000 pounds of hay at the first cutting, 3,250 at the second, and 3,050 at the third, or a total of 5.6 tons per acre. In 1897 I grew more than this to the acre on a four-acre piece, and I often grow 14 tons of silage corn on an acre; so it is fair to use this comparison.

The following table gives the comparative food yields:

	TOTAL.		DIGESTIBLE.	
	Corn, lb.	Alfalfa, lb.	Corn, lb.	Alfalfa, lb.
Dry matter	5,539	10,300	3,605	5,611
Albuminoids	405	1,603	296	1,198
Starch, sugar, etc	3,263	4,782	2,186	3,114
Fiber	1,472	2,800	1,060	1,198
Ether extract	84	246	63	101
Ash	315	829	....	....

A study of this shows that the acre of alfalfa produced nearly twice as much dry matter as the corn, nearly four times as much digestible alubminoid matter, and nearly one-third more carbohydrates. The albuminoids are the expensive things for us to raise on New York State farms, and too much of our money goes west for them. There are not many crops in which we can grow it to advantage, and none save this where we can grow more fat and heat producing material to the acre, than we can grow in corn, and at the same time grow nearly as much digestible protein in every ton as we find in a ton of wheat bran.

In New Jersey they asked what I based my statements regarding corn and alfalfa on. I told them on the results in my own stables, and now I am able to back my own observations with the able experiments of Dr. Cooke.

My friend from Mohawk criticizes me because I am advocating alfalfa growing, and because I use my position as Director of State Farmers' Institutes to encourage my fellow farmers to try it. I believe in speaking well of the bridge that carries me safe over. Alfalfa has been a great help to me and to my father, before me, in keeping a dairy, and if I can help mark my term as Director of Institutes as the beginning of an era of alfalfa growing in New York, I will be content.

Question.— What is an average yield of alfalfa in Central New York, and why does it not do well in certain sections of the State, and what is it?

1. I believe that three to four tons per acre can be depended on one year with another, on good land, with a good even stand. To get this you must cut at least three times, and as we have often cut the first time the last of May, or first of June, there is no trouble in getting three and often four cuttings.

At the Geneva Experiment Station the following yields were obtained:

1894.— 64,596 pounds green matter or 17,034 pounds hay from 2.3 acres, and 33,803 pounds of green matter or 8,116 pounds dry hay from 1.3 acres.

1895.— 37,129 pounds green matter or 8,666 pounds hay from 1.3 acres.

1896.— 34,991 pounds green matter or 8,527 pounds hay from 1.3 acres, and 36,514 pounds green matter or 7,461 pounds hay from 1¼ acres. The first cuttings of these plots for soiling were made May 11th in '94, 12th in '96 and May 15th in '95.

In reply to the second question, I will refer later to the experiments made by Mr. Livingston and others a hundred years ago, as they cover the ground fully. I will detail these experiments for two reasons, firstly to show that the matter of alfalfa growing was carefully considered at that time, that it is not a new crop, as some writers seem to think (because it is new to them), and, secondly, show some causes of failure. It is probably true that there are many farms in this State where alfalfa will not do well, but I am convinced from observation that the plant is not so particular as to soils as some think. It is a deep-feeding plant, and as it is very rich must be a strong-feeding one, drawing heavily on lime, potash, magnesia and phosporic acid. When conditions are favorable, the tap root descends to great depths. I have seen a root that had extended down in a seam in limestone a trifle more than 18 feet, and there were fibers going lower than this. In a government report it is stated that roots 50 to 60 feet in depth have been recorded.

The character of the subsoil has much to do with success in alfalfa growing, and in this as at the surface, drainage is necessary, as an excess of water in the subsoil will kill it as surely as too much water on the surface will. Many of the best fields of alfalfa in central New York are over solid limestone, and in some cases there is less than two feet of soil above the rock. It has been stated by a noted argostologist that alfalfa will not do well on any soil, no matter how rich or well prepared, if the field is underlaid with impermeable subsoil, or by rock or hard pan. While he is correct in a measure, no one on limestone which has more or less seams extending down to moisture, need fear to experiment with alfalfa.

I do not advise anyone to bother with it where the water level comes near the surface, or where the hard pan subsoil holds the water for any great length of time in the spring. On the soils that are best adapted to growing it, it is most often a failure because of one or more of the following reasons: Lack of proper preparation of the soil. The old traditional onion bed surface is none too good. I believe it pays to subsoil, running a subsoil plow in the furrow made by a common plow, and loosening the ground for at least 15 inches in depth; but the ground should be allowed to settle before seeding. If there is the least possible trace of acid in the soil, it should be corrected before the seed is sown.

Too little seed. The labor of preparing the soil is just as great for a poor catch as a good one, and one cannot afford the risk of failure incurred with a light seeding. Use 20 to 30 pounds of good clean seed to the acre.

Impure seed. Buy of reputable seedsmen; some seed has been found that contained, black melilot and other worthless legume seed.

Smothering out of the small plants with another crop sown with it — alfalfa lasts long enough when well established that we can afford to sow it by itself; at times a very light seeding of oats, cut green for hay, seems to be an advantage. Oftimes the weeds and barn grass will come in to such an extent as to injure the crop. These should be cut and drawn off if heavy.

Dodder.— This is the most serious enemy of alfalfa. Be sure there is none in the seed you sow. It is not new in New York. Many gentlemen were experimenting with it in this State from 100 to 150 years ago. In 1812 it was tried in central New York by Sterling Lamson and by Moses DeWitt. L'Hommedieu had it growing in Jefferson county in 1795. In 1851, Commander James Glynn of the United States Navy brought from Valparaiso a cask of alfalfa seed, stating that " it was growing from Panama nearly to Cape Horn, and there forms the principal article of fodder * * * the stalk attains the size of a goose quill, and grows seven to eight feet high."

April 13th '52, Mr. Henry Meigs exhibited a plant with a root a foot in length, even though broken off at the end — and a strong vigorous plant, notwithstanding that the previous winter was very severe. The whole plot was reported as unhurt.

It is stated that about this same time seed was brought from Chili to California, and being a success in that climate from the start, it was soon taken to the arid regions and became a standard crop on the Pacific coast, and is to-day one of the most profitable. The drouths of western Kansas and Nebraska made it popular there after the first few seasons, and the two dry years that we have just experienced are doing more to convince our farmers of its value than all that is being said for it.

WHAT IS ALFALFA?

This question is often raised by eastern farmers who read of its wonderful growth in the West, and many have an idea that while it has revolutionized farming in some parts of the West, that irrigation and arid land go hand in hand with it, and I fear some good men have condemned alfalfa because of their contempt for western irrigation schemes.

The alfalfa which we are growing in New York is *Medicago Sativa:* Lucern or Purple Medick. The name alfalfa is probably of Arabic origin, and came to Mexico with the plant with the Spaniards, and later this name followed it up and down the Pacific coast. The name Lucern is evidently of French derivation, and has nothing to do with the province of Lucerne in Switzerland as the plant is of but recent introduction here, and the gentlemen who brought the seed to the eastern coast of America 100 to 150 years ago all called it lucern. It is difficult to decide what section of the world alfalfa is a native of. It is found in Persia (Media), in fact in all parts of western Asia, it is found growing wild in roadsides, abandoned fields and out-of-the-way places, just as sweet clover grows here. There is no doubt, however, that it was introduced into Greece as early as 500 to 450 B. C., during some of the early Persian wars. It seems evident too that the grand Roman meadows, from which slaves used to weed the "wild grasses" were of lucern. Records of these are found dating as far back as the first and second centuries.

Columella in writing of the methods of these old Romans says: * "They chose out the best land, that was both *Pinguis* and *Putris*; they dunged it, and tilled it to the greatest perfection and laid it out in beds, as for asparagus, and sowed the seed very thick for the miserable reason of enabling the plants by their thickness to better kill the grass.

"The beds being harrowed very fine, before sowing which was at the end of April, the seed required to be speedily covered, lest the sun's heat should spoil it, but not with an iron tool, for the place must not be touched with iron. Medica seed must be covered not with the plow, but with little wooden harrows. Some time after it came up, this scratching was repeated with the same wooden instruments. This was called Sarrition; then by Runcation they weeded it over and over: *Ne alterius generis herba invalidam medicam perimat,* lest other grass should kill it whilst it was weak. The first crop they let stand 'til some of the seed scattered, to fill the ground yet fuller of plants. After that it could be cut young, as they pleased, but they must be sure to water it often after cutting. This was done largely by slaves as was the weeding. The weeding was repeated after each cutting, and by these methods four to six crops were cut each year for 10 years."

Tull says in 1733,[1] "English gardeners make 40 pounds off an acre of asparagus with half the labor these Romans bestowed on an acre of Medica — but as the Roman empire was then in its glory, and Rome the metropolis of the world, where all the richness of the earth was drawn together, the price of hay may have warranted this great outlay of labor. Again, the Romans had not only servants, but plenty of slaves, for whom they had scarce sufficient employment, and this might lessen the expense of this tedious method of planting and ordering the Medica. But when the Romans were brought down to the level of other nations, and were in danger of being slaves instead of having them, and the lands of Italy came to be cultivated by Italian hands only, they found something else more necessary to employ them in, than the Sarritions, Runcations and Rigations of the Medica, and their labor being bestowed in getting bread for themselves, they substituted other grasses of more easy culture for the food of their cattle, and they were so bigoted to all the superstitions of their ancestors that they were content to lose the use of that most beneficial plant, rather than to cultivate it by a new, though more rational method, when they had become unable longer to continue it by the old. And so superstition chased lucern from the Roman empire."

In 1653 Walter Blith, advises in his quaint book, "The English Improver Improved or the Survey of Husbandry Surveyed," the English farmer to try to grow "La lucern, a French grass which is excellent fodder, and should be experimented with, as every day will bring forth something or other worth our embracement."

Seventy-five years later Jethro Tull is urging English farmers to grow it by his method of hoeing — which he seemed to think was a panacea for all the ills that agriculture was heir to, and so on down as books were more easily written we find men telling of the virtues of lucern; but in my effort to show that it is not a new plant, or rather a newly cultivated plant, I am losing sight of the question. It is, according to Prof. Smith,[2] "an upright, branching, smooth, perennial, growing from one to three[3] feet high, with three parted leaves, each leaflet broadest above the middle. The purple flowers are in long, loose clusters or racemes. The ripe pods are spirally twisted, and each contains several seeds." The young plants resemble sweet clover, and many men who have seen the crop for the first time, while visiting me, have asked, "What do the people here do with so many fields of sweet clover?"

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[1] Jethro Tull's Horse Hoeing, 1733.

[2] Jared G. Smith, U. S. Dept., 1900.

[3] I have often seen it four feet high in places in fields where the moisture conditions were favorable.

In Onondaga and Madison counties (central New York) are more acres of alfalfa than in all the rest of the State, and most of the acreage here is in six or eight towns. Under the German name lucern, it was tried here nearly, if not quite, 100 years ago, but so small a quantity of seed was sown to the acre that the hay was coarse and very unpalatable to the animals. As near as I can learn, lucern was sown with other grasses, and but from 2 to 12 pounds used to the acre. Economy in seed was practiced strenuously in those days, and lucern seed cost one shilling six pence per pound. It was also tried in other parts of the State at about the same time.

In 1793 Mr. Robert Livingston of Jefferson county, sowed about 15 acres, dividing the acreage into seven plots, ranging from one-quarter of an acre upward. On each plot a different method was followed and a different soil selected, and but about four acres were pronounced a success in 1794. These, however, were so successful that he advised others to try the crop. His first plot was sown in 1791. Of this he says:

"Mixed two pounds of lucern with two pounds of clover seed; sowed them with oats on one-quarter acre of ground; the soil is sand to the depth of 14 feet, but in good order, having been the two preceding years in potatoes with dung. April 6, 1792, spread two bushels of gypsum. May 25th, the clover very luxuriant; the lucern, though of superior height, branches so little, and is so compressed by the clover, as hardly to attract attention. About the middle of June, cut the grass product in dry hay, a large load for two oxen, or somewhat more than half a ton. August 8th, cut a second crop about five cwt. The summer having proved very dry and the soil being naturally so, the clover did not rise sufficiently to be cut, so that this crop consisted wholly of lucern. I now experienced the want of seed, for, though the lucern was about 27 inches high, it occupied too little space to produce a great crop. The lucern and clover rose after this cutting, and might have yielded a tolerable crop, but I preferred to leave the rowen to protect the roots against the winter winds. April 1, 1793, dressed this plot with one bushel of gypsum. April 28th, the spring proved uncommonly early, the ground being naturally warm, having a South aspect, and the plants having been protected by a good winter coat. The lucern exhibited a most beautiful appearance; it was 13 inches high, the clover growing with it not more than two inches. The common pastures were barely green. As my hay was gone and none to be purchased (the year preceding having yielded but poor hay crops), I was compelled to employ my lucern for feeding four plough horses three times a day in the stable as they came from their work; and four sows and pigs, which were regularly fed with it three times a day; the horses were turned out at night to glean what they could in the pastures; it lasted them until the 23d of May, and what was last cut was near three feet high,—10th of June. Began again to cut for two large coach horses kept together in the stable; it lasted them until the 28th. In this cutting the clover amounted to nearly one-half of the crop, which was, I think, more productive on that account than the one that preceded or those that followed it. On the 28th day of July, mowed a third time for hay; the product, as near as I could judge, about six cwt. dry. The clover aided this crop very little, the drouth having prevented it from rising much after the last cutting, and, indeed, a comfortable part of it had dried out. As no clover appeared after this and the lucern was perfectly free from weeds, I conceived the idea of leaving it for seed, and did not, therefore, cut it when in blossom, as I might have done, and have had a fifth crop; the seeds were not ripe until the 1st of October, when it was again cut, and produced about six cwt. of dry hay. Though the seed looks fair and ripe, and promises to yield a considerable quantity, yet from not understanding the management, or from the lucern's having been touched by the frost, I have been able to make no hand of collecting it; perhaps, after it has laid longer, it will be more easily separated from the pod. April 1st, manured with 10 loads of black earth from a swamp, or at the rate of 40 loads to the acre. It was very luxuriant and cut twice before the 20th of June for plough horses kept in the stable — being, when they began to cut each time, about 15 inches high, the average height, taking the first and last cutting, each time about 20 inches. On the 24th of July, cut and made into hay, produced one thousandweight, or two tons to the acre. On the last of August, cut a fourth time, produce, six cwt., or one ton four cwt. to the acre. The fifth crop is not cut, but is now (the 1st of October) 20 inches high, and very promising in its appearance. If we have no severe frost before the middle of this month, it will produce about six cwt. of hay.

Produce and expense per acre of No. 1:

Expense.

	£	s.	d.
Forty loads of black earth from an adjoining swamp at one shilling per load	2	0	0
Cutting five crops and making them into hay at eight shillings	2	0	0
	£4	0	0

Two first crops value at five cwt. hay each, or	2	0	0
Three crops in hay	2	0	0
Fourth crop in hay	1	4	0
Fifth estimated at	1	0	0
	£6	4	0

Six tons four cwt. at 2s. 6d	15	10	0
Expenses above	4	0	0
Profit	£11	10	0

"There are so many vacant spots in this piece, owing to its being *too thinly seeded,* that *I am satisfied that had I sown the lucern alone at the rate of* 20 *pounds instead of eight pounds to the acre,* the produce would have been at least one-third more, though I believe 11 pounds 10 shillings per acre, after paying for manuring and all expenses, will be deemed sufficient profit to justify the culture of this in preference to any other grass."

Plot No. 2, sown in 1793, was on sandy soil and a failure. No. 3 of the same year was a three-acre plot sown to oats, and on May 1st given eight pounds of clover and eight pounds of lucern to the acre. The oats yielded 64 bushels to the acre and lodged so badly that both the clover and lucern were killed and the stubble ploughed. Of plot No. 4 (1793) he says:

"This is part of the same field. Ploughed twice for barley; once last autumn; once early in April; sown with barley about the 20th. Sowed the next day two acres of this ground with clover and lucern, mixed eight pounds of each to the acre, except about half an acre with lucern alone, 16 pounds to the acre, harrowed with a light harrow. The lucern and clover came up very well, and would have produced about half a ton of hay to the acre had it been mown this autumn; it has been fed down, though not so closely as to injure it. Put in at the same time and in the same manner, one acre upon a strong loam, laying flat, and somewhat wet, the ground having yielded potatoes for the last two years. The lucern after the barley on this ground is very promising, and has not been fed — expenses of the same as above, £6 4 0 on the three acres; however, I am satisfied that the ensuing crop will amply repay the expense."

No. 5 was sown with buckwheat and lucern; No. 6, one-third acre with turnips and five pounds of lucern, and on No. 7 a small strip with lucern alone. This did remarkably well, and would have perfected seed, had it not been cut.

At the end of the second year Mr. Livingston was well pleased with the results, and said:

"From the first experiment, it appears that it may be easily sown on a dry soil with oats and clover, and that its annual clear profits, after deducting every expense, will exceed on the first two years £7 per acre. The failure, therefore, of that sown this year with oats, must be ascribed to the following causes: First, a luxuriance in the oats, which was, by no means, to be expected from the soil, and is wholly to be attributed to the improvement it had received from clover and gypsum, and is so far a striking lesson to farmers, as well as a confirmation of the conjectures I had the honor to submit to the society on the effect of gypsum as a permanent improver of the soil. Second, the oats having been sown on one plowing, so that the ground was less mellow than it should be for the reception of lucern. Third, to the extreme drouth of the spring; clover having not succeeded better than lucern, when sown together. The second experiment proves that ground which has not been ploughed in the spring, or pulverized fully, is improper. The failure, however, of this experiment, may in some sort, be charged to the early sowing, since the rapid growth of that sown with the buckwheat during the hottest season of the year, would intimate that the ground should be warm and mellow to suit the constitution of this plant while in its infant state. The success that attended the sowing with barley proves, that, notwithstanding the unfavorable season, if the earth is properly pulverized, a good product may be expected.

"An important question still remains to be decided, relative to the propriety of sowing lucern alone or mixed with red clover feed. I was prejudiced in favor of the latter mode from the following considerations:

"First, I wished to know whether it was equally hardy with clover? Whether, under similar circumstances, it was able to contend with it in our climate? Experience has convinced me that it will, and that in dry seasons it will flourish, while clover is too faint and languid to raise its drooping head; and what is more extraordinary, that this child of the summer better braves the biting frosts of the spring and the keen autumnal blasts than clover or any cultivated grass of this climate. These are important circumstances, when I am laboring to introduce it into common husbandry in the face of prejudices arising from the English experiments, which are far from encouraging to farmers of moderate capital. I hope, however, to show that it is infinitely better adapted to our climate than to that of Great Britain.

"Second, it having been constantly asserted that it takes three years to come to perfection, and that the prospects are very trifling the year succeeding that in which it is sown, by mixing the seeds with those of clover, I expected, and indeed found, that an immediate profit might be obtained; for the clover came forward as early as if it had been sown alone, was supported by the lucern, which added something to the crop, and both together yielded more than three and a half tons to the acre the very first year; the merit of the last cutting being wholly due to the lucern, since the drouth prevented the clover from rising a second time to the scythe, so that had this field been sown with clover alone, it would have yielded 24 cwt. to the acre, and less than it did by the addition of the lucern seed the very first year. The second year's product is still more conclusive in favor of the lucern.

"Third, as the clover is a beneficial plant, I expected that as the lucern advanced, the clover would die out and leave the ground free from weeds that might have robbed the heritage during the minority of the lucern. Though this reasoning was plausible and influenced my conduct in my experiments this year, yet I am not satisfied that it is just. I argued from English books of husbandry, which, however, are not calculated in this particular for our climate. The principles they maintain are: First, that lucern does not attain any considerable degree of strength till the third year; hence the necessity with them of drilling and hoeing to keep down the weeds. Some that I sowed this year with my barley, as well as a crop which my neighbor, Mr. De La Bigarre, sowed with his, yielded, on being cut this very autumn after his barley, almost 11 cwt. per acre, convinces me that its growth here is more rapid than in England. (In this, however, it is not particular, as I shall on some other occasion show that plants grow more rapidly by two-fifths here (New York State) than in Britain.) I am, therefore, very doubtful whether it will *pay as much and as early, provided from* 15 *to* 24 *pounds of seed are sown to the acre,* as the mixed crop would. This I shall next year ascertain with accuracy. Should it be established on experiment, the clover seed should be omitted, as it tends to check the lucern, and to render the crop thin when it dies out; besides, that neither springing so early, nor bearing drouth so well, it must be considered as inferior in every respect to the lucern. There is one consideration, however, in its favor, and that is that in warm situations the lucern will be fit to cut before the clover rises to the scythe. The second crop in this case will be earlier on account of the clover, which will consist almost wholly of it, because having escaped the wounds which the lucern received it will be ready to take the field before the lucern has recovered from amputation.

"There are two considerations which render weeds here less troublesome than in Britain — the severity of our winter and the heat of our summer. Many from the first of these causes are annual here, which are perennial there, by being able to live through their mild winter. The slightest fallowing in the heat of summer kills most weeds here, while, in England, their moist climate enables the greatest part of them, like *Anteus*, to bid defiance to wounds and bruises, if they are permitted to but touch their parent earth. We may add to this that the indigenous weeds of this country are few, because the children of the forest, as well of vegetable as of animal tribes, fly the haunts of men; the only troublesome weeds we have are convicts, that have been transported from our mother country. They must, therefore, necessarily be much fewer than those that remain behind, not only because the habits of many of them are too delicate to assimilate themselves to our unpolished climate, but because their number in both countries must be proportioned to the time from which they began to be cultivated, and to the extent of their commerce, for weeds and vices are the children of cultivation and commerce. Nor will they ever be eradicated in an improved country till some agricultural millenium shall advance cultivation to the highest possible point of perfection. All these considerations form decided arguments in favor of the cultivation of lucern (whose greatest enemy is said to be weeds) in this country, rather than in England. Upon the whole, then, I would recommend, as the result of my experiments, as far as they have yet gone:

1. Never to sow on ground that is not perfectly pulverized.

2. Not to sow until the earth has acquired a degree of warmth friendly to rapid vegetation; that is, not earlier than the month of May.

3. To sow with no crop that will probably lodge.

4. If sown with buckwheat, to apply no gypsum or other manure till the buckwheat is off.

"5. Where the quantity to be sown is small and the farmer can afford to lose a crop, to give the ground one turn in autumn, another in April, harrowing it fine, and a third the beginning of May, and then if the weather is mild and warm, sow, if the ground is in perfect tilth, otherwise give it another plowing; 18 *or* 20 *pounds of seed are not too much — were it not for the expense I would prefer* 25 *pounds if an early crop is the object.*

"I fear that I have, in the opinion of many, dwelt too long on this subject. If I have, my apology will be found in my anxiety to impress upon my countrymen the importance of cultivating this plant, which I am satisfied is better adapted to our climate than clover, which exacts more labor; which leaves (I speak upon the authority of Young's travels) the soil much better than it found it; which will even bear pasturing; having myself remarked two plants in a common pasture which had defied the bite of cattle for upwards of 20 years, one of which is still alive.

"These considerations have induced a conviction in my mind that the man who introduces a plant which promises to be so important to agriculture will have a better claim to the gratitude of his country than any other, that one only excepted, whose civil and military virtues have afforded us the means of pursuing, in peace, our rustic labors. I confess that I am not ambitious of that honor. To the rich I have facilitated the means of procuring the seed, which has hitherto been very rare here; small parcels I have distributed to common farmers, whose exertions I have stimulated by showing the flourishing state of my little field; nor can I conclude without addressing myself (in the words of the

Gospel) to every member of the corporation who is blessed with equal or greater means, 'Go and do thou likewise.'"

A year later he reported that "the lucern sown over the wheat in the spring of 1793 yielded nothing, so that the whole of this must be stated as loss, except that the expense of gypsum should be deducted from the account, as it produced a very noble crop of white clover, on ground on which I should have otherwise have had little pasture."

"It is, however, to be remarked that the red clover seed sown over the wheat at the same time, in the manner mentioned in the experiment, succeeded no better than the lucern; this must be attributed in part to the season. The experiment of lucern upon wheat should be tried again, but only on a small scale, as I am inclined upon the whole to think it will seldom succeed.

"The lucern sown with the oats, as I mentioned, was so choked by it as to promise nothing; that sown with buckwheat very little, for the same reason, and both were plowed up. The remaining experiments are those in which the lucern was put in with barley and with turnips. The first of these I must divide into two classes: first, that sown on light loam, and, second, that sown on clay.

"Profit and expense per acre, of two acres of lucern, sown with barley and clover, April, 1793:

	£	s.	d.
26th June, cut and made into hay	1	2	0
26th July	1	5	0
20th September	1	4	0
	3	11	0
Expense per acre cutting and making 8s. per acre	1	4	0
3 tons 11 cwt. of hay, at 2s. 6	8	17	6
Deduct expenses	1	4	0
Clear profit	£7	13	6

Part of this was injured by the poultry and pigs, which were constantly upon it. Those parts on which clover was mixed with the lucern very much inferior to that on which the lucern grew alone."

Lucern and Clover on Clay.

"This cut only twice, the second time the 20th of August; the product at both cuttings three tons to the acre. The first crop was much injured by the cattle breaking in and by its being lodged. The lucern among the clover is now fit to cut a third time, but having been sown thin it will not make a crop alone, and the clover is too short to be worth cutting; but the after-grass is so fine as to be adequate to all the expenses attending the two first crops, so that three tons of hay or £7 10s. may be considered as the net profit upon this acre."

Lucern Sown with Turnips, August, 1793.

"I expressed my fears that this lucern would hardly live through the winter; however, I was agreeably disappointed. Early in the spring, though the plants were small, and, as I thought, much too far apart, yet, as the season advanced, they shot forward very luxuriantly, and this piece has been cut three times with that sown with barley. Although sown nearly four months later the first crop was nearly equal to the barley sown, the second and third much superior to it, so that its acreable produce may be stated at four tons. Its future product will be greater than any I have, as it is perfectly even, without any vacant spots, and uninjured by the clover which I sowed with my other crops.

"The introduction of a new plant is liable to so many difficulties from ill management and prejudice, that I think it important still to continue the register of my experiments at the risk even of tiring the patience of the society.

"I remember the avidity with which I read everything that I could find on the subject, before I began my own experiments, and I remember too, how much all I read fell short of my wishes in many particulars, which I am now able to elucidate for the benefit of others."

In 1794, he sowed seven plots, as follows:

Experiment No. 1.

September, 1793, plowed up four acres oats-stubble, soil a light loam — 1791–1792 in clover, manured with gypsum; 1793, in oats, yield very great — about 54 bushels to the acre.

April, 1794, plowed twice. May 1st, sowed two acres with barley and 35 pounds of lucern seed, which I covered by the roller.

"This barley was but tolerable, yielding about 20 bushels to the acre. The lucern is far from answering my expectation; it is thin and in patches; the rains which prevail this summer have filled the ground with clover, so that I expect next year to cut more clover than lucern from this ground."

Experiment No. 2.

"The adjoining acre was sown with lucern alone without barley. It looks at present exactly as that sown with barley, neither promising much as a lucern crop. I should observe that these plants came up very thick and well, but soon changed their color in spots to yellow, and died away, except where the ground was rich."

Experiment No. 3.

"Plowed up three-fourths of an acre that had been in potatoes last year, soil as above; dung was put in the rows when the potatoes were planted at the rate of 40 loads to an acre.

"May 1st, sowed with barley and 12 pounds of lucern seed; the barley good, but much injured by the poultry, being near my house. The lucern, a very fine and promising crop, cut about the last of September, about half a ton to the acre. This experiment is important, since it proves that if lucern is sown in the spring it should be on the ground in good health and warmed with dung. I have no doubt of cutting four or five tons of hay next year from this spot."

Experiment No. 4 — *One Acre,* 1794.

"Soil as above, but poorer, sown this spring with vetches, they were cut 20th of July for hay, plowed immediately after, and put in 18 pounds of lucern seed; it came up very thick, and maintains a healthy color, though the ground is very full of weeds; this gives me no uneasiness, as they are annuals, and the season too far advanced to permit them to ripen their seeds; they will only serve to protect the lucern against the cold of the ensuing winter."

Experiment No. 5.

"Half an acre of my last year lucern standing very thin. I plowed it up this year, and 1st of July sowed it with eight pounds of lucern seed and a small quantity of turnip seed, having previously manured the ground with stable dung. This, with a very wet season, has brought up so many weeds as to injure the lucern by overshadowing it, though it came up very vigorously. On the 20th of August mowed the weeds and turnip tops, which were very large, not, however mowing very close. The lucern at this time, October 1st, though very full of weeds, has a fine, healthy appearance, and I have no doubt of its doing very well. The turnips do not appear to have been injured by the mowing."

Experiment No. 6.

"Soil as above. May 1st, planted three-fourths of an acre with early potatoes. The beginning of August 1st took them up and put in upon one plowing 12 pounds of lucern seed. This has come even and thick, and is very free from weeds. If it stands the winter, which I hardly doubt, it will make a very fine crop the next year."

Experiment No. 7.

"One acre of gravelly clay sown this spring with vetches left for feed, cut about the last of August, and the beginning of September, sowed with 16 pounds of lucern. It is now October 1st, but just beginning to show itself, owing to there having scarcely any rain fallen since; and the result of this experiment will determine whether it may safely be sown with wheat in good soils, and how far it is capable of bearing cold when very young."

Mr. Livingston, having made, with a view to introduce this very useful plant (as I believe), more experiments, and upon a larger scale than any other farmer in America up to that time, drew the following conclusions, and based upon them, gave instructions to others who might choose to cultivate lucern:

"First, it appears to me to be fully as hardy as clover, and like it, to delight in a warm, dry soil, though it will flourish in a moist clay, subject, however, to the same casualties in open winters, when both will be thrown out by the frost.

"Second, when very young it requires a natural or artificial warmth in the soil, otherwise it languishes, and when the weeds and natural grasses come up, it is unable to contend with them.

"These two observations point, first, to the soil in which it should be sown; to-wit, a warm, dry soil in tolerable heat; the second, to the means of procuring the warmth which I speak of as necessary to the plant. This may be obtained in two ways. First, by dung, and, second, by sowing when the sun has given the earth an additional heat. If spring sowing is intended, I should prefer a ground that had been manured and bore a potato crop the year preceding, because by that time the weeds which the dung produces will have been destroyed by the hoeing of the potatoes. If no such ground is ready, and a spring sowing is intended, the dung should be plowed in July or August, and the ground harrowed fine. This will bring the weeds forward, when a second plowing and the winter will destroy them before they have perfected their seeds. The lucern may be sown early in May, 12 pounds to the acre, after the ground has had three or four spring plowings with barley, which will pay the expense of the manure and plowings.

"Second mode by which the seeds will come up quicker, and with more regularity, is to manure early in the spring, and to plow and harrow the ground fine when the weeds have sprung and got some head; and when the earliest kinds begin to blossom, plow again and harrow fine; repeat this four times by the 1st of July, when the lucern seed should be sown (16 pounds to the acre), every seed of which will then germinate. The seed should always be sown when the ground is dry, and rolled in; if committed to the ground while it is very moist, the seeds will swell, and if a dry season succeeds before they have struck root, they will wither away.

"Third, lucern is frequently liable to turn yellow and look sickly. I have not been able to discover the cause of this evil, though I have carefully examined the roots with a microscope. The remedy is to mow the plant; it will come up free from the disorder.

"Fourth, the time for cutting this for cattle is whenever it will fill the scythe; for hay, when it begins to blossom. If left till the blossom turns it becomes too hard. I would prefer cutting for cattle the first year, as this effectually destroys all weeds.

"Fifth, it may be fed down by any kind of cattle with as much safety as clover.

"Sixth, I would recommend it to the young farmer not to be discouraged from pursuing the culture of this plant by the observations of some of the older ones, who will tell him that Mr. A. and Mr. B. tried it, but it would not do. Experiments carelessly made or not regularly pursued, the accidental circumstances of soils or seasons, afford no conclusive arguments, as may be inferred from the register which I have exhibited. Out of about 15 acres, which I sowed last year, but four succeeded. Had I not tried the plant in various ways I should probably have determined that it was not worth attention. My errors and instructions will render the work easier for those who choose to attempt future experiments, and whether they succeed or not, they will render agriculture some benefit by communicating the result of their experiments."

Among others who experimented largely at the same period was Mr. John Stevens, of Hoboken, who sowed lucern on three plots in 1793, but reports the plants as thin and scattering, and not "fit for much," and says:

"1. From the almost total failure of lucern on No. 1, we may fairly conclude that the seed was committed to the ground too early in the season, especially as the clover that was sown with it succeeded very well.

"2. The indifferent appearance of No. 2 may, I presume, be attributed principally to the want of a proper melioration of the soil. A fit matrix for vegetation was thereby, in the first place, wanting, and in the next place the plants of those seeds which did vegetate were nearly suffocated by weeds.

"3. The luxuriant growth of the lucern on No. 3 would countenance a conclusion that lucern may succeed very well when sown on barley without clover.

"4. Upon the whole, these experiments, as far as they go, indicate that lucern ought not to be sown early in the season; perhaps, midsummer may prove the fittest time for sowing it. That every care should be taken to render the ground as mellow and as free from weeds as possible, and that, therefore, it would be most advisable to prepare the ground the succeeding year by a crop of potatoes, pumpkins, or other horse-hoed crop, with which a generous coat of manure should be laid on so as to supersede the necessity of manuring the lucern, except, perhaps, with a top dressing of ashes, etc.

"Perhaps no subject of rural economy will eventually prove of more importance to the American agriculturist than the culture of lucern. From the habits of the plant it appears admirably fitted to our climate. It requires heat and endures drouth, and on a soil properly adapted to it, it will last from a dozen to 20 years in full perfection."

In 1792, Mr. Peter De La Bigarre says: "It is not true that lucern can grow everywhere. It requires a light but substantial ground, not too dry or too wet; it delights in a deep and gravelly soil or rich sand, where it may root down easily, rather upon a level spot than on mountains or declivities. As much as possible I would choose a situation sheltered by woods or hedges from the cold winds in the winter and from burning breezes in the summer."

Tillage and Sowing.

"The ground intended for lucern must be plowed twice before winter, 15 inches, or at least a foot deep.

"In the latter end of March you plow it again and dress it with a harrow before the day of sowing. The seed is buried in the ground by the harrow, taking care to fix chatwood or branches under and betwixt the teeth in such a way as to facilitate the covering of the feed without going too deep into the ground.

"There are two ways for sowing the lucern. The first, *by itself, which is the best.* The second, mixed with barley or oats, but *observe not to mix lucern with any other perennial.*

"Whether lucern is sown by itself, or mixed with barley, *take* 20 *pounds weight for an acre.* If you choose to sow it with barley, take the exact measure of the quantity of barley which you are used to sow upon one acre, then put in that measure 20 pounds of lucern seed, fill it up afterward with the barley. That process will establish the just proportion.

"If you intend to sow lucern by itself, fill up the measure with sand or ashes over the above-mentioned quantity of seed. That method makes the sowing easier and more regular.

"When your barley is ripe you may mow it as close as possible to the ground without any danger of hurting the young plants of your lucern, of which you cannot expect but a very indifferent crop the first year. Don't let cattle feed upon it at that time.

"The second year will give you two crops. In the beginning of the third year, as soon as the winter is over, you must harrow your lucern about two inches deep when the ground is yet moist, in two or three different directions, in order to root out the weeds. Never mind nor be uneasy if your lucern is torn to pieces by that hard dressing. The more it is torn the better it will grow. This is a fact of long experience upon which you may rely."

Manure.

"After the above dressing you may manure your lucern with greater advantage by spreading over some new ground or mud taken from creeks or swamps, or employ some pulverized gypsum.

"The best manure for lucern which I know of is the dung of fowls and pigeon-houses, well dried by the sun and reduced into powder, but it seems very scarce and too difficult to be got in this country, although a great deal less of this last manure would be required, as in the proportion of one to nine. Dung of cows, horses, or any other cattle, ought to be rejected as bad manure upon lucern, because they bring with them such a quantity of weeds as to poison the best lucern in the course of two years."

Produce.

"The third year the lucern has acquired its full strength; then, upon a common average, one acre will produce, viz.:

The first crop	2,500 weight.
The second crop	1,400 weight.
The third crop	600 weight.

"After the third crop, let it be fed upon by your cows all the remainder of the fall.

"Such a piece of lucern will last from 9 to 10 years. But however great may appear the profit of that culture, there is a greater one after the lucern is worn out — I mean the richness afforded to the ground by the roots of that plant, which is such that the first year that the lucern has been plowed up I was never able to raise wheat which grew too rich, tall, luxuriant and lodging. Instead of wheat, then, you must sow barley or oats."

Mowing.

"The most proper time to get good and tender forage, relished by the cattle, is to mow lucern when in full bloom, or a little before the ripeness of the seed.

"Another advantage of mowing early is to have the weeds cut down, which otherwise would come to seed and spread over the field.

"When the weather is clear, one or two days are sufficient to dry your lucern hay, and by spreading over each row a thin bed of any straw (that of oats and barley is the best) you may carry your lucern to the barn without any danger of being heated or rotten. The straw so intermixed with lucern, receiving the juicy emanations of it, becomes more palatable, and it is eaten like the best hay by the cattle. It would be needless to observe what increase of food that process affords to a farm."

Disorder.

"In some uncommon summers, it happens that lucern is attacked by caterpillars or other insects. When this is the case and you perceive the stems and leaves turning pale, yellow or fading, the only and best remedy is to mow instantly your lucern, which will soon grow again, fine and free from those insects."

I have taken pains to relate all these reports fully, that we may have before us the results of the first experiments in alfalfa culture in America. Had our people followed up the work of Mr. Livingston, we would have gained greatly. In the central New York towns that I have mentioned alfalfa is a standard crop, and I may safely add that more than one-half of the hay cut in five towns in Onandaga and Madison counties this year is alfalfa.

Temperature and Moisture in Relation to Cheese-Ripening.

By L. L. **Van Slyke**, Ph.D., Chemist, New York Agricultural Experiment Station, Geneva, N. Y.

Read at the meeting of the New York State Dairymen's Association at Watertown.

Under the general term of "ripening," as relating to cheese, we include all those physical and chemical changes occurring in cheese that tend to bring it into a marketable condition, or rather into a condition suitable for consumption as food.

I do not propose to consider here any of the details involved in cheese-ripening, except those relating to loss of weight and in a limited way to commercial quality. While we have been studying other important changes, time permits for presentation here a choice of only one phase of work, and of the information in hand I know of nothing that would be so timely to our New York cheesemakers as the consideration of the limited topic I have chosen.

Over two years ago our legislature generously gave us a new dairy building, and in its equipment our director, Dr. Jordan, saw to it that more attention was bestowed upon cheese-curing rooms than upon all other details put together. The object was not to secure rooms that would be available only for everyday cheese-factory work, but to have rooms, without regard to cost, in which conditions could be controlled as closely as possible, in order that we might learn what would take place under the exact conditions desired.

We have a block of six distinct curing-rooms, separated from the outer walls of the building by a passage four feet wide. The rooms are farther insulated by double walls and air spaces on every side of each room. Each of the rooms is 9x10 feet and about 8 feet high, and the wall space on three sides is provided with shelves 12 inches apart.

The temperature and moisture in each room can be controlled independently of the other rooms. It is possible to get a range of temperature varying from below 40° F. to 90° F. in any room. Each room is provided with a hot-air flue from below, and a cold-air flue from above leading from the chamber in the attic which contains ammonia expansion coils and brine tanks. These two flues, one for cold and one for hot air, are closed by dampers and these dampers are operated by means of compressed air tubes controlled by thermostats. There is also a ventilating flue in the ceiling of each room. The thermostat is set so as to register a definite temperature in each room. For example, in one room it is set at 70° F.; when the temperature falls one degree below 70° F., the thermostat is affected in such a manner that it turns a valve and this causes the compressed air to open the hot-air damper in the floor. On the other hand, when the temperature rises to 71° F., the cold-air flue in the ceiling is opened. Thus we have an alternate admission of hot air and cold air, causing the temperature to rise or fall above or below the given point at which it is desired to hold the room. So delicate is the operation of this system that merely breathing upon the thermostat will open the cold-air flue, while fanning the thermostat will open the hot-air damper. We are therefore able by this system to hold temperature within a very limited range. Under most favorable conditions limit of variation is only two degrees. Even with a much wider variation the temperature of the interior of a cheese would not be affected to the extent of more than a small fraction of a degree, as we have shown by placing a thermometer inside a cheese and keeping it there for some weeks.

It would be impossible, even with the help of drawings, to give a completely intelligible description of our arrangement for controlling temperature. The system itself must be seen in operation.

It is more difficult to control moisture than temperature, and hold it within narrow limits. The most practicable and efficient method we have found is to make use of yard-wide pieces of coarse felt having strong capillary power. One end of the felt dips into a trough of water situated near the top of the room, and the lower end drops in a trough placed on the floor. The water is sucked in by the felt at the upper end and gradually distributes itself throughout the whole piece, the excess of water dripping into the lower trough. It is necessary to boil the cloths occasionally in water slightly acidulated with some acid, like acetic or hydrochloric, in order to remove mineral matter that accumulates and interferes with the capillary action. In most of the rooms we have thus far kept the moisture as nearly as possible at 75 per cent. of saturation, though variations of 10 per cent. are apt to occur at times. The moisture is of course more easily managed at the lower temperatures. In the rooms held at temperatures of 65 and 70° F., it required about four yard-wide pieces of felt to keep the moisture near the point desired. Most of our work thus far has been confined to studying cheese at different temperatures with uniform moisture.

The changes in composition of cheese which take place in curing under ordinary favorable conditions are for the most part of two kinds: First, loss of moisture, and second, changes in casein, resulting in the formation of soluble nitrogen compounds from insoluble casein.

It has been fairly shown that fat in cheese changes chemically but little, if any, during normal cheese-ripening.

LOSS OF MOISTURE IN CHEESE-RIPENING.

The loss of weight in cheese during the process of curing under proper conditions may be regarded, for practical purposes, to be due entirely to the evaporation of water from the cheese. Of course the mechanical loss of fat by exudation from cheese when the temperature is allowed to go too high must be considered, and in a serious way, but we are assuming that such a condition ought not to be allowed to happen, and it will not with a proper control of temperature. The small amount of loss due to formation and escape of carbon dioxide or other gases from cheese can be neglected for the purpose we have in view.

A gentleman who ought to have known better made the assertion in a signed article that water in cheese was very different from other water. It was a case of knowing for certain something that isn't so. Water, whether in milk, or butter, or cheese, however much its presence may be disguised, is the same kind of water as that with which we are familiar everywhere. It is just plain, everyday, common water, and possesses no characteristics to distinguish it from the water we drink and handle, aside from possible impurities in the latter.

The rapidity and extent of loss of water in cheese-curing vary with several conditions, chief of which are the following:

1. The amount of water originally present in the cheese.

2. The temperature of the curing-room.
3. The size of the cheese.
4. The shape of the cheese.
5. The proportion of water-vapor present in the air of the curing-room.

The results to which your attention will be called are based upon averages secured under the special conditions employed, these being temperatures of 80°, 75°, 70°, 65°, 60°, and 55° F., with a moisture content of air varying from 65 to 85 per cent. of saturation, and averaging about 75. I would not have you understand that these results are to be accepted as representing all conditions, nor even as representing absolute facts in all cases under the conditions employed. They are rather to be received as a general guide and suggestion, some of the details of which may be modified by more extended work.

For the sake of ready comprehension, the figures express results for 100 pounds of cheese, unless otherwise stated, and the results are given in round numbers.

The Amount and Rate of Loss of Moisture as Influenced by the Amount of Water Originally Present in Cheese.

In the table following we show the amount of water present in the green cheese and the amount lost per 100 pounds of cheese for each of four weeks under uniform conditions of moisture and temperature:

Pounds water in 100 pounds green cheese.	Pounds water lost by 100 pounds cheese.			
	One week.	Two weeks.	Three weeks.	Four weeks.
55	9.00	11.15	12.25	16.75
50	5.50	9.20	12.00	12.90
45	4.45	6.30	8.00	9.45
35	3.30	4.20	4.90	5.70

An examination of these figures shows a general and marked tendency for very moist cheese to lose water more rapidly than cheese having less moisture, other conditions being uniform. The cheese having 55 per cent. of moisture at the start, lost about three times as much each week as did the cheese having 20 per cent. less of water, and not quite twice as much as the cheese having 10 per cent. less of moisture at the start.

As the moist cheeses lose water much more rapidly in proportion, the moisture in the different cheeses tends to become more uniform; but, so far as our observations go, they would not all reach the same condition of water-content, except under very unusual conditions.

At the end of four weeks the cheese containing 55 per cent. of water has lost approximately one-third of its water; the one containing 50 per cent. has lost one-fourth; the one containing 45 per cent., one-fifth, and the one containing 35 per cent., one-sixth.

This fact is a matter of general interest, rather than of practical importance under the usual conditions present in cheese manufacture. But there is a practical question in this connection to be considered later.

Your attention is first called to the loss of weight found with different sizes of cheese at different temperatures.

The figures given in the following table represent the amount of water lost for 100 pounds of cheese:

Diameter of cheese.	Temp. of curing room, deg. F.	Pounds of water lost for 100 pounds green cheese.							
		1 week.	2 weeks.	3 weeks	4 weeks.	8 weeks.	12 weeks.	16 weeks.	20 weeks.
Seven inches	80	3.7	5.3	6.4	7.4	10.8	12.7	14.4	15.8
Seven inches	75	3.3	4.8	5.8	6.7	9.3	11.2	12.7	13.7
Seven inches	70	3.0	4.6	5.4	6.2	8.8	10.7	12.3	13.5
Seven inches	65	2.7	4.0	4.9	5.8	8.0	9.7	11.0	12.0
Seven inches	60	2.6	3.8	4.7	5.6	7.8	9.4	10.6	11.7
Seven inches	55	2.5	3.5	4.6	5.3	7.4	8.9	10.1	11.1
Thirteen inches ..	70	2.6	4.1	4.8	5.3	7.4	8.9	10.3	11.3
Thirteen inches ..	65	2.5	3.7	4.6	5.0	6.8	7.8	9.2	10.3
Thirteen inches ..	60	2.2	3.6	4.3	4.6	6.5	7.7	8.8	10.0
Thirteen inches ..	55	2.1	3.5	4.2	4.5	6.3	7.6	8.4	9.5
Fifteen inches ...	80	...	...	...	5.0	9.3	12.4	....	....
Fifteen inches ...	75	...	...	...	4.6	8.0	10.1	12.1	....
Fifteen inches ...	70	...	...	...	4.4	5.9	7.8	9.2	10.4
Fifteen inches ...	65	...	...	...	4.2	5.6	6.6	7.5	8.6
Fifteen inches ...	60	...	...	...	4.0	5.5	7.0	7.9	8.9
Fifteen inches ...	55	...	...	...	3.8	5.4	6.3	7.2	7.8

Attention is called to the following points:

1. The total loss of moisture is greater the first week and every other week following at a temperature of 80° F. than it is at the lower temperatures.

Loss of Fat at 80° *and* 70°.

2. The average weekly loss or rate of loss is greater in every case as the temperature is higher. This statement can be brought out more clearly by means of this table:

	Average loss per week in ounces.					Total loss for five months—lb.
	First month.	Second month.	Third month.	Fourth month.	Fifth month.	
At 80° F.........	29.6	13.6	7.6	6.8	5.6	15.8
At 75° F.........	26.8	10.4	7.6	6.4	4.8	13.7
At 70° F.........	24.8	10.4	7.6	6.0	4.0	13.5
At 65° F.........	23.2	8.8	6.8	5.2	4.0	12.0
At 60° F.........	22.4	8.8	6.4	5.0	4.0	11.7
At 55° F.........	21.2	8.4	6.0	4.8	4.0	11.1

3. The loss of weight is greater in every case the first week than during any week following, usually being greater than the total loss during the two or three weeks following put together. This is true for every temperature.

This comparatively rapid loss of moisture during the first week is in part due to the fact that the bandage holds considerable water and this quickly dries. Then too the outer surface of the cheese, in drying, begins to harden, the pores of the cloth filling also to some extent, and this tends constantly more and more to diminish evaporation, provided cracking is prevented.

Influence of Size of Cheese upon Loss of Moisture.

The larger a cheese the greater is the amount of surface exposed for evaporation, and the greater will be the amount of water lost from the cheese, other conditions being uniform; but the proportion of loss, that is, the loss per 100 pounds, is smaller in the larger cheese, because the area is smaller in proportion to weight in larger cheese.

By referring to the preceding tables, the variations of loss with cheeses of different diameters can be readily seen. In the following table we show variations of loss for cheeses having a uniform diameter, but varying in height, all kept at the same temperature and room moisture:

Height of cheese.	Loss of moisture per 100 pounds of cheese.							
	1 week.	2 weeks.	3 weeks.	4 weeks.	8 weeks.	12 weeks.	16 weeks.	20 weeks.
Three inches	3.5	5.4	6.5	8.6	10.8	13.2	14.9	16.2
Five inches	2.8	4.2	5.5	6.3	8.7	10.2	11.8	12.6
Seven inches	2.3	3.4	4.7	5.6	7.8	9.3	10.5	11.4

Here we find the proposition of loss decreases in proportion to the height of cheese.

Influence of Shape of Cheese upon Loss of Moisture.

Which would lose moisture more rapidly, a cube-shaped cheese or a round cheese, the weight being equal? I have no experimental data to offer in answer to this question, but if my calculation is not at fault, the square cheese has the greater superficial area and would lose moisture more quickly if it were a properly behaved cheese.

The Influence of Moisture in Air upon Loss of Moisture in Cheese.

The relative amount of moisture in air, or, more properly, the degree of saturation, probably exercises a more marked influence upon the loss of water in cheese-curing than any other single factor. I regret that I am unable at this time to present satisfactory data covering this point, as our experimental work has not progressed far enough to permit any specific, reliable statements beyond the general one that the influence is very marked. I hope to accumulate data abundant enough to enable me to speak with some degree of definite authority.

In experimental work, moisture is very difficult to control, and at best quite wide variations are likely to occur.

SOME PRACTICAL APPLICATIONS.

I will now briefly call attention to some of the practical applications that the results presented may suggest:

1. To the cheesemaker and the dairyman water is money when put in the right place in right quantities. It is essential to put it

there as nearly right as may be and then keep it there with the least possible loss.

The actual amount of water that cheese should contain hardly lies within the province of my subject, but it may be of interest to state that in cheese-factory work in New York, the moisture in the green cheese usually amounts to 36 to 37½ per cent. in the regular cheddar cheese. For export purposes a somewhat smaller amount of moisture is retained. For home trade, cheese made in the fall, the moisture more often lies between 38 and 40 per cent. It is safe to say that for our average American cheese-eater a moisture content of not less than 33 to 35 per cent. at the time of consumption is desirable.

From the dairyman's standpoint, it is desirable to sell as much water in cheese as will suit the consumer. Taking everything into consideration, I believe better results will be secured in quality by holding less moisture in the green cheese and curing it so that it will lose only a small amount of water, rather than by holding a larger amount of moisture in the green cheese and so curing that a larger amount of moisture is lost.

2. The more completely a cheese dries out, the harder is the rind and the greater the loss to the consumer. Most people plan to throw away a rather thick rind. In a carefully-cured cheese the rind is comparatively moist and only a very thin portion need be lost, and even this can be used in cooking.

3. In preventing excessive loss of moisture, we have more water to sell at cheese prices. I have made inquiries among some of our New York factorymen as to their losses of weight in cheese-curing. One of the most complete records, covering an entire season, made by a cheesemaker and factory-owner who has probably better than average conditions for curing-rooms, made the average loss of weight during thirty days amount to about five pounds per hundred pounds of cheese. Some factories try to get rid of their cheese at three weeks, to escape some of this loss.

Consulting our table of moisture loss, we find that the loss could easily be reduced one-third or more, and there could be for every hundred pounds of cheese one and one-half or two pounds of water to sell at cheese prices, meaning about 15 cents more per hundred pounds of cheese. This gain may seem slight, but it means $1.50 for every ten thousand pounds of milk, and for a fair-sized factory it would mean several hundred dollars a season.

4. In making small cheeses, like Young Americas, the proportion of loss is much greater, and hence the demand is still more im-

perative that these shall be cured under conditions where the loss of moisture shall be smaller. I am not surprised that the manufacture of small cheeses of the cheddar type has been discouraged. Even at the higher prices brought, the extra loss of moisture and additional cost of manufacture are not satisfactorily covered.

INFLUENCE OF TEMPERATURE OF RIPENING UPON COMMERCIAL QUALITY OF CHEESE.

When cheese comes into market, it must be judged by certain commercial standards that have come to be recognized, and so it is important that this kind of judgment be applied to any experimental work that deals with conditions affecting in any way the commercial quality of cheese. Our cheeses have been examined from time to time both by our own station expert and also by others whose assistance has been called in at intervals.

1. In every instance, cheeses cured at lower temperatures were scored higher after two and three months than those cured at higher temperatures, though there was in some cases little or no difference between the temperatures 60° and 55° F.

2. Cheese cured at 70° or more scored less at six months than at three; while cheese cured at 55° F. scored higher in both cases, and, moreover, showed decided improvement in flavor at six months as compared with three months. The rule is for cheese cured at higher temperatures to acquire a more pronounced flavor, sooner or later becoming more or less sharp. Cheese cured at lower temperatures acquires a mild flavor and retains a uniform flavor for a much longer period of time.

I do not know that any one is yet in position to say with any degree of fullness how cheese acquires its flavors, but that they are bacterial products we generally hold and with reason; but the details of the problem remain to be worked out.

The influence of temperature upon the texture or body of cheese is marked. At temperatures of 60° F. and below the texture was rarely found otherwise than perfect, while at 65° F. and above it was generally imperfect, especially after two or three months. At higher temperatures the great tendency is to become crumbly and mealy to a greater or less extent, becoming more marked as the cheese becomes older. This is undoubtedly due to the drying out of the cheese or loss of moisture.

In a recent conversation with one of our New York cheesemakers, a gentleman who operates twenty-two factories, he told me that he thought a crumbly texture was always due to tainted milk. I am equally sure that any cheese made from good normal milk will acquire a crumbly, mealy texture, if the water is allowed to drop much below 30 per cent. and probably even before. The exact minimum amount of moisture a cheese must carry to maintain a perfect texture I am not yet able to state. Of course, a cheese carrying extra fat in proportion to casein would not come under the same rule as average normal cheese.

As the practical application of these results, attention is called to these points:

1. At higher temperatures, loss in quality of cheese in curing is marked. Even at a temperature of 70° F. the quality is not maintained, compared with a temperature of 60° F. or 55° F., especially after the early stage of ripening. During June, July, and August, the temperature in many curing-rooms will average 75° F. or more, and how high it goes at times is limited only by the degree of heat outside and the capacity of boards to absorb and retain heat. Even where the difference of temperature varies so little as 10° or 15° F., say 55° F. or 60° F. and 70° F., we may safely place the commercial difference at a cent a pound after the early stage of curing. This difference would mean ten dollars a day for every 10,000 lb. of milk made into cheese. This condition is likely to prevail for two or three months at least; and when you have to heat the curing-rooms, as many do, with stoves, in the spring and fall, an ideal condition of curing does not prevail in respect either to temperature or moisture.

Higher curing temperatures mean lower quality, less money and less cheese eaten.

2. With cheese cured at lower temperatures, the curing takes place more slowly, to be sure, but it is *improving* all the while and acquires the power of long keeping. Long after cheese cured at higher temperatures deteriorates, the other is getting better constantly. This is no small advantage, enabling one to hold cheese for better prices, if desired.

I believe that improvement in quality, made by curing cheese at lower temperatures, will be a very great factor in promoting the consumption of cheese.

We may try to persuade the American people that cheese is a most economical and concentrated form of food; we may talk to them about its digestibility; we may use every possible argument to prove to them that they ought to be more sensible and eat more cheese; but the average American cheese-eater, so far as I know him, doesn't want high-flavored, sharp-tasting cheese and he stops eating it when he can't find any other kind in the market. Give him a cheese sufficiently moist, well broken down, dissolving easily on the tongue, of mild flavor, and he will eat more, and you will have to make more of the same kind.

I am aware that there is a class of cheese eaters who want mild cheese and think they can get it only by eating cheese very imperfectly ripened; they will take it at three or four weeks and I suppose they will insist upon cheese that they can chew on, that won't dissolve easily in the mouth, or in the stomach either. We should try to overcome this vitiated taste, for it is eating this kind of cheese that has given so many people an exaggerated idea of the terrible demands made by cheese upon the digestive organs. This class of cheese-eaters is hardly worth catering to in the long run, for even they are mortal and they usually become confirmed dyspeptics and stop eating cheese altogether.

I cannot refrain from emphasizing the suggestion made by Dr. Babcock and Dr. Russell two or three years ago in regard to centrally located buildings especially erected for curing purposes, taking care of the product of several different factories, wherever such an arrangement is feasible. Only by some such system is it probable that ideal conditions can be secured in every respect.

My sole object has been to call attention more fully to the results to be secured by proper conditions of cheese-ripening and point out the losses suffered by lack of such conditions.

History and Influence of the New York State Dairymen's Association.

By B. D. GILBERT.

Read at the meeting of the above association at Watertown.

The New York State Dairymen's Association dates back to the early days of associated dairying in this country, inasmuch as it was the outgrowth and result of the older American Dairymen's Association. All cheese dairymen will remember that the first cheese factory built in this country, and that means in the world, was the one erected by Jesse Williams in 1851, in Oneida county, New York. For seven or eight years there was very little increase in the number of factories, dairymen assuming a somewhat critical attitude toward the new method and desiring to investigate it thoroughly before embarking in it. But about the year 1860 the factory system began to become more popular, and new factories sprang up in different parts of the State. In 1861 Mr. A. P. Willard tells us there were thirty-four factories in Oneida county, with a considerable number in Herkimer, Montgomery, Jefferson, Cattaraugus, and Chautauqua counties. By the year 1864 dairymen began to feel the need and importance of coming together at least once a year to compare notes and learn what they could from each other. Under the lead of their two most prominent men, Prof. L. B. Arnold, who for many years was the only really scientific man in the cheese business of this land, and Hon. Harris Lewis, one of the most level-headed practical men, a meeting was called at Rome, N. Y., where the American Dairymen's Association was then formed. Hon. Horatio Seymour was made president and retained that office as long as the association lasted; Professor Arnold became secretary and Harris Lewis, treasurer. There is said to have been great enthusiasm when this association was formed, and for some years the conventions were attended by delegates from many parts of the country. But after a time it was found that the dairy business was extending so rapidly that it was impossible to maintain a national association, which this aspired to be, especially when its meetings were all held at one place, viz.: Utica, N. Y. As a practical man, Harris Lewis saw that the work of such an association must be confined within narrower limits in order to make it a success. So a call was issued for a meeting of New York State dairymen, which took place at Syracuse, February 19, 1877. Here the State association had its birth, and Hon. Harris Lewis was made the first president, with Hon. Josiah Shull for secretary. An entirely different policy was pursued from that of the American Dairymen's Association. Instead of tying the annual conventions down to one town or city, they were held every year in a different place, thus drawing a larger number of dairymen within the sphere of their influence and making friends in many different quarters. In order to show how widely scattered the conventions have been, I have summarized them as follow: Places at which only one convention was held: Binghamton, 1878; Whitney's Point, 1881; Ogdensburg, 1883; Jamestown, 1885; Norwich, 1886; Middletown, 1887; Oswego, 1888; Ithaca, 1889; Walton, 1890; Cobleskill, 1892; Gouverneur, 1898. Places at which convention has been held twice: Syracuse, 1877 and 1895; Oneonta, 1879 and 1894; Delhi, 1880 and 1896; Owego, 1884 and 1891. Places at which the convention has been held three times: Cortland, 1882, 1897, and 1899; Watertown, (——), 1893, and 1900. Thus, it will be seen that in twenty-three years the convention has visted seventeen places, four of which it has visited twice and two only for three times.

So much in the way of mere history. Time does not permit to go into detail concerning the officers and men who have from time to time been connected with the association. It should be stated, however, that Hon. Harris Lewis continued to occupy the president's chair until 1886, when failing health compelled him to decline re-election, and John S. Shattuck of Norwich was nominated by Mr. Lewis himself and elected *viva voce*. Mr. Shattuck served the association for two years very acceptably and thereafter a new president was chosen every year. Other prominent men who, although not officers of the association, took an active part in its proceedings, but have already joined the great majority, were Hon. Josiah K. Brown, the first dairy commissioner of the State; Col. F. D. Curtis of Kirby Homestead, a genial associate and enthusiastic dairyman; Hon. Josiah Shull, secretary of the association until 1890, when he resigned on account of declining years and was made president for that year; Prof. L. B. Arnold, for many years the most experienced man in the country in the chemistry of the dairy, and Dudley Miller, a prominent breeder of Holstein cattle.

In speaking of the work and influence of the New York State Dairymen's Association, it is impossible to do more than select a few of the most important subjects which have been acted on at different periods of its history. At the very first meeting of the association at Syracuse, a petition was framed to be sent to the Senate and Assembly "to pass such laws as will protect the farmers of the State against frauds in the manufacture and sale of fertilizers," and this petition struck the keynote of the association's efforts ever since. That note has been, "Down with frauds and imitations masquerading in the guise of pure goods." A committee was appointed to lay this matter before the legislature, and the following year this committee reported that they had waited upon the Senate committee of agriculture and had conferred with the executive committee of the New York State Agricultural Society, and they believed the time was ripe for a united effort to procure an appropriation for establishing a State experiment station. This I believe was the earliest movement in that direction. At the Delhi convention in 1880 the same committee made a further report, showing that it had pursued its work until the legislature of the preceding winter had passed an act establishing the New York Agricultural Experiment Station. Its labors therefore were accomplished and the committee asked to be discharged.

At the same convention there appears the first action I have been able to find in our records concerning oleomargarine. A law had already been passed prohibiting oleo., and this resolution recommended "an amendment of the law requiring the branding of oleomargarine by the manufacturer, was to compel all retailers to inform their customers of its character when offered for sale, and that hotel and restaurant keepers be considered as retailers and compelled to give notice to their guests when oleo., sueine, or other imitation butter is set before them." The agitation on this subject was kept up and in the early winter of 1884 President Lewis and two or three other prominent members of the association went to Albany to consult with Senator Henry R. Low of Orange county, upon an act which should establish a dairy commission in this State with an appropriation sufficient to enforce the existing laws against imitations of dairy products. With a law already in existence prohibiting both their sale and manufacture, except under proper restrictions, there was no means of enforcing the law until the dairy commission was established. Senator Low's bill passed the legislature that winter, and within 10 days Hon. Josiah K. Brown was appointed chief dairy commissioner. Our convention that year was held at Owego, and both Senator Low and Commissioner Brown attended and delivered addresses explanatory of the law and hoping for the assistance and co-operation of the association. And so the association was again one of the active forces in the enactment of a vitally important law.

There is one other action taken by the association which was of special weight and consequence. At the Oswego convention of 1888, Col. F. D. Curtis occupied an entire evening with an address on "Dairy Education," speaking for more than two hours. Part of the address was written, but much of it was spoken off-hand, as the colonel was so thoroughly imbued with his subject and so earnest in its advocacy that he needed no written notes except for the dates, figures, and quotations. I remember that he brought with him an armful of consular reports from which to read what they had to say about dairy education in European countries. I doubt if that address has ever been surpassed in its way, and the argument he made for dairy instruction in this country was simply convincing and unanswerable. Notwithstanding the great length of his address, the audience, which was composed chiefly of members of the association, listened to it attentively throughout, and at its close Mr. H. W. Richardson moved that a committee of three be appointed by the chair "to present the subject of dairy schools to the legislature of this State." President Shattuck appointed as such committee, Mr. Richardson, Col. Curtis, and our present presiding officer, Mr. Geo. A. Smith. I cannot say positively whether the whole committee went to Albany that winter or not, but I know that Col. Curtis went and presented the case to the committee on finance so convincingly that an appropriation was voted to the association that winter for the purpose of dairy education, and seven dairy conferences were held the succeeding summer. These were not the first however. This subject had been talked of among the officers of the association the preceding year, and as the legislature had then granted a small appropriation for defraying the expenses of the association, Secretary Shull had inaugurated the educational system by holding two "butter conferences," as they were called — the first at Richland, N. Y., August 10, 1887, near the farm of Mr. W. H. Gilbert, who made the arrangements for the meeting; and the second at Minnie Dale Farm, Chemung, N. Y., August 12th, at the dairy of our lamented friend, Jesse Owen. These were the first efforts at popular dairy education in this country. We are so accustomed to dairy meetings and farmers' institutes in this present age of progress that we can hardly appreciate what an effort it was to give the initial impetus to all this work and to push it till it became a success. That is what was done by the New York State Dairymen's Association, and other States seeing the success of the work adopted somewhat similar plans. The Dairymen's Association in the summer of 1889 held thirty-nine conferences and that continued then until 1892, when the number held was twenty-six.

It will be seen from what has been said that the influence of the association has always been wide, practical, and beneficent. It has stood from the very beginning as an earnest advocate of pure goods, whether in cheese, butter, or milk. It has worked successfully to prevent dairymen from being handicapped by imitations and substitutes. It has made its influence felt in legislative circles. It has brought to the front in its conventions the latest and most approved methods and improvements in dairying; and it is certainly worthy of the hearty indorsement and approval of the dairy interests of New York State, which it has done so much to educate, broaden, strengthen, and place on a higher plane of intelligence and success.

It is our sad duty to record the decease of three members of the New York State Dairymen's Association during the past year. The first of these was Jesse Owen of Elmira, who was president of the association from December, 1891 to December, 1892. This is not the first time the association has been called on to mourn the loss of an ex-president. Hon. Harris Lewis and Hon. Josiah Shull had preceded him. Although Mr. Owen, in the latter part of his life, was a man of leisure, he owned the Minnie Dale Farm, Chemung, where a fine grade of butter was always made, and he kept up his interest in it to the last. His interest in this association also was unfailing. He was one of its original members, and until declining years made the journey too much of a burden he never missed attending the annual convention.

He was a peacemaker by nature and his genial presence always assured harmony and union in the ranks of the association. Those of us who belonged to the earlier days of the association can but recall his inspiring influence and the helpful tact with which he assisted in our proceedings. Therefore, be it

Resolved, That we sincerely deplore the demise of our friend and associate, Jesse Owen; that we desire to recognize his sterling qualities, and the happy influence which he exerted in our councils; that we honor his memory as one of our oldest members and officers; and that his death brings home to us the fact that the number of original members is rapidly decreasing, and that soon there will be no more of them left.

The second decease to take place in our ranks this year was that of William Mather, of Adams, who died April 17, 1900. His parents were from New England families, and they settled in Adams, in 1820, on the farm where all their children were born. He was one of the most progressive farmers of that region, and at his death one of the heaviest landowners in the town. At his death, all the farming community felt that they had lost a valuable friend. As a member of this associaton he was always generous in his donations, and greatly interested in its progress.

Resolved, That in the decease of William Mather the association has lost a true and generous friend, one who was devoted to the cause of education, whether in the school or on the farm, one who believed in elevating the people, and in making better men and women with each succeeding generation.

The third and last member to pass away this year was Major C. P. Root of Gilbertsville. Major Root was not only a model citizen who took great interest in the local affairs of his place of residence, but during the civil war he occupied a position of great trust and responsibility, and fulfilled its duties with ability and success. So thoroughly imbued with patriotism was he, however, that he would never accept any compensation for these services beyond his mere expenses. Afterward he became extensively interested in the dairy business, and if we are not mistaken he also was one of the original or very early members of our association. Of late years he has managed some twenty butter and cheese factories in his own and adjoining counties, and has had the reputation of making the finest imitation English dairy cheese produced in this country. For many years he was a regular attendant at our conventions, but we believe that his last appearance at one was at Cortland, in 1899.

Resolved, That we desire to express our sincere sorrow at the demise of Major C. P. Root, our old friend and associate; that as a man of high ability and unblemished character and a dairyman of large experience there were few who were his equal; that it is a distinct loss to this association to have such a member pass away beyond recall; and that the community at large is made poorer by his death.

All these were men who did what they could to lessen human want and suffering, and to elevate the masses. They were all earnest and sincere believers in the Christian religion, and each of them approached his end with an unfaltering trust.

> "Like one
> Who wraps the drapery of his couch
> About him and lies down to pleasant dreams."

Dairy Bacteriology.

By Prof. H. A. **Harding**, Bacteriologist New York Agricultural Experimen Station.

Notes which formed basis of Address at meeting of New York State Dairymen's Associatio at Watertown.

Mr. President and Members: I begin this talk with fear, not for lack of subject-matter, but for fear that I will use unintelligible language. For I am to tell you of conclusions reached by the aid of bacteriology, an infant science, and one which has only recently begun to extend a helping hand to dairying. It is unfortunate for us that I must mention the word bacillus, for the mere mention of the word calls to mind a host of erroneous impressions and misconceptions. If I were to talk about cattle or cheese I would have the satisfaction of knowing that my auditors had a good idea of the object that I was speaking of and would occasionally receive sympathetic nods of approval. But when I tell you that I have found a bacillus to be the cause of ropy milk, I feel alone here, for there is only one other in this audience to contradict me. I must necessarily beg you to stretch your imaginations to think of bacteria, those minute things visible only under the microscope, as units in nature, and deserving your serious attention.

Ropy milk is of practical importance to the milk dealer and consumer alone. The cheese-maker here is interested in this matter only in that it will explain a common phenomenon and one very similar to that encountered by him in slippery whey.

Objectionable on account of its unwholesome appearance, change dealers with insinuations that the cows are not healthy, or that you have weeds in the pastures, or that the feed is wrong. Belief that it is garget milk. Ropy, not slimy, when drawn. Garget milk is slimy when drawn.

Cause.— A bacillus, not a disease producer. Erroneous idea of medical side of bacteriology.

A harmless mass of viscid slime, living in water naturally, and which would not of his own accord harm milk. Unfortunately for us he is inclosed in a slimy, sticky jacket. Hang together for the same reason that a fly sticks to flypaper, and when enough are present in any liquid, that liquid becomes viscid. When I lift this stringy milk, the bacteria in it are arranged in the position seen in the chart, the cohesion of the sticky coverings being sufficient to maintain the weight of the liquid.

These bacilli are naturally unoffending. They cannot walk, fly or jump into milk; victims of circumstances, and these circumstances are under the control of the dairyman. I want to emphasize the fact of the innocent intent of these bacteria; they never get into milk unless they are helped there.

Conditions in average concern experiences trouble. Small milk-house. Milk brought in and strained, bottled. Cooling cans in ice water high outside; splashes in fine ice; lifting out cans; perhaps don't scald; dirty strainers; slight dust; rinsing pails at night.

What bacteriology reveals: Bacteria in the milk; bacteria in the water in tank; bacteria in village water supply, sometimes; floor dust, how found; cans standing open; strainers, how found; air-stand sterile milk; poor can washing; innocent dealers.

What to do.— Scald well, boil; cover cans in the tanks; potassium bichromate in tank; supervise the milk production carefully or produce your own; 5 per cent. oil vitriol on floor.

Recapitulation.— Germs in water; may dry up on floor and blow in; dirty utensils; careless rinsing of pails at night; impossible to foresee all conditions; must work out own solution.

I invite your correspondence in regard to trouble, for my knowledge concerning it is not yet burdensome.

The Evolution of Dairying.

By **Jared Van Wagenen, Jr.**, Lawyersville, N. Y.

Delivered at the meeting of the New York State Dairymen's Association at Watertown.

If we should try to point out any single watchword which might be said to represent the dominant thought, the most prominent philosophy of the last half of this century, that watchword would be evolution. And the term evolution does not mean that man by some mysterious sort of a breeding-up process was derived from a monkey or a tailless ape. That is the most common, most crude and, I think I may say, most vulgar conception of a great physical and spiritual truth. But in its broader sense it means, not only that so far as organic nature is concerned do we stand in the presence of a constantly changing and, therefore, unfinished creation, but it means also that what is true of vegetable cell and towering tree, of bird and beast and creeping thing, of lurking savage and civilized man is true as well of art and science and religion and society, true also of all the physical, moral and spiritual forces of the world. And evolution means too, that we have come to see more plainly the hoary truth that everywhere, in the realm of nature and in the realm of social and commercial activities, there is being waged the fiercest of battles — the never-ending struggle for existence — and that out of this conflict there is being evolved the most perfect adaptability because the whole struggle tends only to one end — the survival of the most fit. To-day men use the philosophy of evolution to explain almost everything. They trace, with breaks perhaps and many surmises, the tiny simple animal cell up through long ages in many forms until it blossoms into the highest of animal life. They trace society, from the half brute man roaming wild in the forest or hiding in the grass, up to the time when the idea of the family first came in and children bore their mothers name because there was no means by which their fathers should be known; so on up through the clan and the tribe and the feudal baroncy and the nation and all the complexities and wonders of our Christian civilization. They take our old Bible and point to the growth of the religious idea, to the great gulf crossed between the Pentateuch and Paul. And this evening I want to talk to you for a few minutes and, if possible, to interest you in the unfolding and the development of the oldest of occupations. The early history of dairying can never be written, it can only be guessed at, because its beginning is buried in the unfathomable past. We can only know that before man reared any architectural monuments for himself and before he left any written word, pressed into clay or graven in stone as a memorial of his generation, before this the dairyman arose. And there was a time back of that when man roamed through the forests a naked root digger, creeping on his prey and killing it with his unaided fist or with a stick or stone, tearing their raw flesh with his teeth or rudely shaping their skins into a covering against the cold. But when did there creep into his benighted brain the great idea of taming and rearing these animals in order that he might have them always at hand and make them minister to his wants in meat and skins? And then some day — I think we may allow ourselves to imagine that it was in a beautiful effort to save the life of a little child whose mother had died, some genius of that far-off time conceived the idea of drawing milk from the udder of some female of his herd and that day the first dairyman stood forth. I love to think of that dim morning twilight of the human race — of the days when cities were merely collections of mud huts beside the watercourses — when nations were only chieftain clans and wars were only family fueds. And when I read the old Testament I stand in the dawn of history. I see the cattle upon a thousand hills. I hear the lowing of oxen and the bleating of sheep and the tinkling of the bells of the camels and I know that it was a goodly land "flowing with milk and honey."

The first grazier wandered with his flock where his fancy led him or where the pastures were greenest, until finally his pasture ground began to encroach upon the pasture ground of his neighbor and that was the cause of the first war. After him came the later man who set up his boundaries and with solemn form and covenant claimed a certain definite portion of earth for a possession for himself and his children after him forever. It is interesting to note how from the earliest times the ownership of land has been considered an almost sacred right and its possession, sale, and inheritance have been guarded by law with especial care and made secure in stately legal phrase and ceremonial. In the days when there were no stock quotations in Wall street and when industrial securities and government bonds were not, a man's wealth was measured solely by the number of his flocks and herds. Then too, when you think of it, how much of social and economic evolution is revealed by the fact that the Latin word for money and for cattle trace to the same root. And from this far off primitive condition how great, how striking has been the unfolding, the evolution? Through the hand and brain of man and the unchanging laws of nature, how great the transformation? Evolution touched the wild cow roaming through the forests of Europe and she became the gentle Jersey or the brown-eyed Holstein. Evolution found the Arab of the desert shaking milk in a goat-skin bag to get butter and beneath her influence it built itself into the combined churn and worker. Evolution found our English ancestors creaming milk in a hollow gourd and in the fullness of time there was heard the soft murmur of a great separator. Evolution looked on men following the cowkeeper's art, without knowledge, without intelligence, without thought and beneath her magic touch his drudgery blossomed into the science and the art of dairy husbandry.

But someone will say that while this may be all true, yet we are not so interested in what our ancestors did in the past as in what we are going to do in the future and that the bad practices of our forefathers have very little connection with the price of cheese on the Watertown board of trade or the quotations for creamery extras in New York city. And because I feel the force of this I want to try and interest you for a few minutes in the evolution of dairying as it has taken place in our memories, as it is going on around us to-day and as it will probably go on for the years to come.

First I want to speak of the cow, because (the Chicago and Kansas City packers always accepted) no one has been able to engage in the dairy business without taking the cow into partnership.

So note this: That in the cow in modern times there has been evolution from two different causes along two distinct lines. First, the cow has been changing in an unconscious effort to fit herself to her changing environment; and secondly, she has been changing because of man's selection in his effort to bring her to a new ideal.

If there is one primary and unchallenged doctrine in Darwinism, it is that all life is a struggle for existence and that only the fittest survive. In a state of nature the vast majority of individuals perish, leaving no progeny to hand down their characters to future generations. In the long run only those survive who are particularly fitted for and are victorious in the struggle. And before man took a hand in her destiny, what was the fit cow? It was not the one with incurved waxy horns. It was not the one with a back level from the horns to the setting on of the tail. It was not the one with incurved thighs and a prominent pelvic arch. It was not the one with big milk-veins and double-chest extensions. It was not even the cow that could give 10,000 pounds of milk containing 5 per cent. of fat in twelve months. But it was the cow who could beat off the wild beast that would devour her young. It was the cow who had hardiness and vitality to live through the time when vegetation was buried deep under the winter snow. It was the cow who, when there was not food enough for all, had strength and stamina enough to be among those who survived the famine. In short the best cow of that day was the one who was enabled to overcome the daily and almost hourly vicissitudes of that time.

But man has changed all that. When we domesticate the cow and provide her with food and shelter her against the cold; when we kill the offspring of some and preserve the offspring of others, then we have reversed the economy of nature and no longer put a premium on hardiness and brute strength. And so for thousands of years the cow has been dropping off some of her old characters and has been assuming some new ones. So here we have changes due to environment.

And then we have another vast series of changes due to man's conscious selection. Note here that man's conscious selection of the cow has not always been toward the same ideals. It is perhaps strange, but I think true that it was beef rather than milk that first attracted the attention of breeders. It is 150 years since Bakewell brought the now extinct Long Horns to great perfection, and bred Old Comely with the fat on her sirloin six inches thick. It is more than 100 years since the careful recording of Short Horn pedigrees was begun. It is ninety years since the Short Horn bull Comet sold for 1,000 gr. ($5,000), but it is less than fifty years since we began to keep records of production or to record the pedigrees of animals bred for milk instead of beef production.

The most evident development of the cow is in accord with the constantly growing conviction that she must be selected along special lines for special purposes. We are coming by common consent to believe that the most profitable dairy cow is one built with a certain physical conformation and temperament, and that this same conformation is not consistent with the most economical production of beef.

It is told of Booth, the great Short Horn breeder, that he used to walk down behind those magnificent mountains of flesh where every calf stood between two cows, and striking his hand upon their padded rumps would say, "What does a few quarts of milk from a cow amount to?" And to-day the intelligent dairyman asks, "What does a hundred or two pounds more or less of inferior beef amount to?"

So much for the evolution of the cow considered as a machine. Since the Spanish-American war we have been very fond of speaking of "the man behind the gun," and so I want to speak of the force behind the cow. Two things must interest every dairyman and they are what he takes out of the cow, and what he puts into her. And after all, I sometimes think the greatest and primary question connected with dairying is feeding the cow. And certainly changes here are evident enough. The old regime and directions for feeding the cow were simple and comprehensive. It was grass and warm water in summer, and hay and ice water in winter. If the pastures were abundant, so much the better. If the drouth came and they were scanty, it was no use to murmur — the ways of Providence are inscrutable and past finding out. We are moving toward a time when pastures shall be the main dependence for only six weeks of the year; when quick growing forage crops shall carry us till the wonderful maize is mature and when with early cut hay and ensilage, and nitrogenous by-products, the cow will scarcely care whether it is June or January. The greatest invention which has come to the dairyman within a generation is not the separator, it is not the Babcock test, it is not the feeding standard, but it *is* the silo. And this newly-developed science of storing green forage has worked almost a revolution in the practice of the winter feeding of the cow. And not this; that while the silo has been a great help to the man who has availed himself of it, it has (because of the cheaper production it has made possible) been a stumbling block in the path of the man who has refused to avail himself of it.

There has been the evolution of the cow herself; there has been the evolution in our ways of feeding the cow, and let us look for a moment at the evolution in the care and marketing of her products.

In the memory of many of you, almost in the lifetime of we of the younger generation, the manufacture and sale of butter, milk and cheese has grown from a local industry, carried on by thrifty housewives beside the kitchen fires, to a great organized and systematized business. For more than a hundred years New York city drew its daily supply of milk from the farmers of Manhattan Island. Those were the palmy times, when Harlem and Bloomingdale were remote country villages, and the Bowery, as the name still indicates, a shady lane through which the thrifty citizens drove their cows every morning to pasture. And when the growing city began to feel the need of more milk than could be produced on Manhattan Island, a ferryman broke the corner on the price by bringing a supply from the mainland in his skiff. It is hardly fifty years since the Erie railroad ran the first milk train, bringing milk from the then almost immeasurable distance of forty miles. And now, every day in the year, fast trains rush into New York bringing more than 25,000 cans of milk from five different States, some of it almost 400 miles away.

And this already great milk-shipping business is constantly growing and promises to become the principal dairying business of the New England and eastern States. The city consumption of milk is increasing by leaps and bounds because supply creates demand, and because the people are coming to know that milk is not primarily a luxury, but that it is one of the cheapest and best foods in the world. As a rule, the greatest growth in population is being made in the cities of the old and thickly-settled States. Southern New England, New York, Pennsylvania, and New Jersey are getting wondrously full of people. The time has already come in portions of Massachusetts, and much of Connecticut, the time will ultimately come here, when the cities will take the entire dairy products of these eastern States in milk and cream — leaving butter and cheese to be imported from more distant localities.

And the cheese industry has been wonderfully developed. For centuries the dairyman has made cheese, by rule of thumb, an individual art, not a science. When Jesse Williams, in 1851, began to make up into cheese at one plant the milk produced by his sons on neighboring farms, I hardly think he dreamed he was laying the foundation of a factory cheese system which forty years later should produce annually nearly one quarter of a billion pounds of cheese. Since Jesse Williams' pioneer days there has come in exact knowledge of temperature, the rennet test, a rational theory of ripening milk, and these together with investigations of the chemistry and bacteriology of cheese-making are doing much to reduce to a science this most difficult and complex of dairy arts.

But it is in butter-making, where, judged by the standard of mechanical improvement, evolution has been greatest. It seems to me that above any other theme, the poetry and romance of farm life has clustered and entwined itself about butter-making under the old regime. But some way we cannot but feel that the times have dealt hardly with this. The cow with the crumpled horn is with us still, but the merry-milking maids, with their brimming pails and rounded arms have tripped away into the shadowy past, and we can never see them more unless we shut our eyes. The mossy, sweet-smelling springhouse that we used to read about has given place to an ugly creamery beside the dusty country road, and the soft swash of the dash-churn is lost in the metallic whirr of the combined churn and worker, while the bewitching dairy maid whose rosy charms the dim light but half revealed and half concealed has been displaced by a man with bushy whiskers, a dirty shirt, and a rubber apron. And sometimes when we dream a bit it seems as if the world were poorer thereby. Soberly, we honor our mothers or our grandmothers who in bygone days, from the eight-quart pan and the dash-churn, brought forth a golden product colored with the juice of the carrot, and nevertheless an honor to them and to their art. But all that is changed. The hum of the first separator sounded the beginning of the end of individual dairying. Once a method was found of handling large quantities of milk quickly and economically, and butter-making began to follow the tendency of the age toward co-operation and aggregation.

And butter-making has developed wonderfully in its geographical range. There was a palmy time when Orange county made the butter for New York, and when the notes of the old Orange county bank were printed in golden yellow to indicate that butter was the source of the wealth and prosperity of the county. The other day I picked up an old *Cultivator*, published in Albany fifty-four years ago this ninth of December, and in their market column there was recognized two grades of butter, Orange County and Western Dairy. Orange County meant butter made in that part of the State, and Western Dairy meant butter from up State, and possibly from Ohio and Michigan shipped down over the old Erie canal and the Hudson river. And the industry spread until the cow worked herself into every narrow valley and on to each windy hilltop of that famous old dairy county of Delaware. Westward the Star of Empire takes its way, and westward the dairy cow took her march, through New York State, into the western reserve, into Indiana and Michigan. And all those years it had been a very pleasing superstition that successful dairying must always be confined to the eastern States. Men were glad to believe that there was something about the water or the soil, or possibly the air which would forever keep the cow out of the valley of the Mississippi. But the industry itself never recognized any such barriers. It has crossed the Missouri and the rockies. It has gone to the Pacific and the gulf of Mexico. It is not yet thirty years since butter went west to Chicago and now the dairyman of Iowa and Illinois and Minnesota and Wisconsin has challenged the dairyman of New York, and has beaten him at his own game.

Viewed from the standpoint of capital invested, what a wonderful industry this dairy business has grown into. It is one of the pathetic stories of the Pilgrim Fathers that for some years there was only two or three cows in the whole colony. And there is a pretty story of the delight of the demure Priscilla when at last her husband was able to tell her that he was the owner of a whole cow for their very own. But to-day if we were to decide to marshal all the cows of New York State into a monster live-stock parade, and could start them out of Buffalo along the line of the New York Central tracks, marching in close order, four cows abreast, each cow pressing close on the heels of the one ahead, the van of that great procession might march down Battery park in New York before the rear guard had left the city by the lake; and bear in mind that this refers to the milch cows of the State of New York alone.

We have seen that the development of dairying has been along three separate lines, the supplying of milk, the making of cheese and the manufacture of butter, and it seems to me that these three lines represent different phases of progress. I want to say, without offense to any one, that the selling of milk as usually conducted represents the lowest development of dairying. Somehow, there seems to be something demoralizing about the forty-quart milkcan. And the reason is not far to seek. As a rule the men who are buying milk in the country have insisted on the only thing — that it should come up to the State standard for fat, together with reasonable cleanliness and sweetness, when delivered. They have demanded only that which any man who could milk cows at all could produce. They have, on the whole, offered a low-grade price and they have been content to receive a low-grade product. There is another trouble at the bottom of the milk-shipping industry, and it is this: The fact that the milk is sold from the farm makes it a farm without calves or pigs, so that the skill and intelligence of the breeder is not needed. What is true of milk-shipping is true of cheese-making as well, although just as soon as the system of paying for cheese, as measured by the amount of fat, is introduced, just so soon a new and educative factor comes into the problem.

But butter-making represents a still higher evolution of dairying, because it not only means producing milk but it means producing milk, with constant attention to the per cent. of butter fat it contains, and beyond that the young live-stock which come up about every butter-producing farm are a constant incentive to study and enthusiasm. And if you should ask me what is the highest evolution, the perfect flower of dairying, I should tell you that it is the making of butter upon the farm. The man who does this must march in the very front rank of the dairy procession. Not only must he make milk like the shipper; no not only must he make milk and raise young live-stock like the man who patronizes the creamery, but in addition he must have the skill to manufacture, and the business ability and training to find a market for his product. I believe in the public creamery. I believe it has been of inestimable benefit in taking from the already overworked farmer's wife a tedious drudgery. I believe that to patronize one may be the wisest thing for ninety-nine men, and I believe that to make the butter on the farm at home may be the wisest thing for the hundredth man. It is said that many years ago all over eastern Massachusetts, the boots and shoes were pegged in the little shoe shops located on almost every farm, being sent out from the factories, and returned when done. But one day a man perfected a wonderful machine, which would peg more shoes than a score of cobblers, and that day the occupation of all those farmer shoemakers was gone — all except one man, and he continued to make shoes, because he made shoes that would fit, and the very man who had invented that marvelous marchine made a pilgrimage to this cobbler to be measured and fitted for a pair of shoes. So, too, I believe, that with all our modern tendency toward co-operation and aggregation, when a superlative dairy article is wanted it will be made on and sold from the farm.

But I have neglected to speak of what is by far the most important example and subject of evolution, and that is the evolution of the dairyman himself. After all, the man is infinitely greater and better than the cow. And the dairyman has grown from a man, who was required to know only how to put hay into a manger and draw milk into a pail, into a man who realizes that he is dealing with a great and complex wonder. While dairying has been growing from a rude art into a great science, the dairyman has been growing from a laborer into a student. That thousands of cow-keepers have remained untouched by this upward movement makes the truth none the less real.

O, my friends, there is no man on earth into whose face we may not look with pride and say, "I am a dairyman — a student of the wonders and the mysteries of the cow." The value and the nobility of a profession is not measured by the dollars we can get out of it. It is not measured by the leisure or the ease that it may leave us in this world. But the question we must ask of any profession is this: Does it uplift and not degrade those whom it touches? Does it bring out of me the very best physical and intellectual possibilities that are within me? And when you think how the foundations of dairying are laid in the deep things of God and nature, when you think what a clean and worthy calling it is in every way, it seems to me that as nearly as earth-born occupations can, it measures up to these ideals.

The Next Step in the Education of the Farmer.

By W. H. JORDAN, Director New York Agricultural Experiment Station.

Delivered at meeting of New York State Dairymen's Association at Watertown.

This is a convention of dairymen. The primary object of your meeting together is for the discussion of those facts and conditions which are important to your special lines of business. But this is also an assemblage of farmers who sustain broad relations to agricultural pursuits and who as husbands and fathers and citizens who have, or should have, great concern about the intellectual and social status of our rural people. You will do well if you go back to your homes with clearer views of agricultural practice, but you will do better if you carry with you at the same time a broadened understanding, and an inspired purpose concerning the manward side of the farm.

It may be accepted as a trueism that we must first produce a better man in order to produce a better farmer, and that if our fields and dairies are to show evidence of more intelligent methods we must begin by cultivating their owners. More than this, we are never to forget that man himself is the object of first consideration, and that the farm is to serve him and not he the farm. It is for such reasons as these that we are intensely interested in the problem of education. How shall the work of the school and the college best meet the needs of agriculture for knowledge of a special kind, and at the same time aid in conserving for us those intellectual and moral qualities which must be our defense against business and social disasters, is a question of the highest importance and is pertinent to this occasion.

I shall present two propositions for your consideration at this time. The first one, and certainly not a new one, is that public education should take account not only of what man is but of what man is to do. I have little sympathy with the creed of the closest philosopher who holds that the culture of the mental powers fulfills the whole purpose of the classroom. Many of us who witness the hard and sometimes unequal struggle of the farmer with his environment are convinced that the schoolhouse should be to him and to his successors not only a refinement but a utility. Beside accomplishing other desired ends, it should, so far as possible, train the powers of observation and furnish fundamental knowledge of a special kind.

But without dwelling longer upon this proposition at this point, let us clear the ground for further discussion by reviewing the conditions under which the agriculturist of to-day is carrying on his work, conditions which stand in sharp contrast with those prevailing when this old century was young. In the first place the farmer is asked to consider an agricultural creed based upon the facts of science. He is admonished on every hand that to doubt and defy this creed will bring on him the retribution that falls to the lot of unprogressive men. He has presented to him a philosophy of farm practice of which the alpha and the omega are the deductions of the laboratory as to the sources of fertility and the avenues of waste, as to balanced rations and unbalanced, as to plant and insect pests, and as to the whole round of means and methods. If he takes up his family paper, that curious compound of accurate and inaccurate information in agriculture, domestic science, politics, and religion, he is confronted by scientific terms, extracts from station bulletins, articles from the pen of pseudo scientists who wrestle blindly but resolutely with the limitations of a little dangerous knowledge, discussions of new fertilizers and feeding stuffs, and spraying liquids, in fact the farmer holds in his hands a modern newspaper, the product of modern conditions.

If the potato-grower steps into the market-place he is confronted by at least twenty best potato fertilizers, each with a formidable statement of composition. The dairyman finds in the same place bags of commercial feeding stuffs with so much protein and so much fat marked on them as required by law. The market gardener and fruitgrower have their attention called to fungicides and insecticides and numerous forms of apparatus for applying these. In the winter the farmer attends, or should attend, the farmers' institute where he hears for the most part sound, common-sense doctrines clothed in a semi-scientific garb with an occasional lapse, by way of contrast, from both common-sense and science. When the rural delivery postman stops at the door he leaves the station bulletin on the pages of which is found useful information conveyed in a judicious mixture of scientific terms and the language of practice. In fact our farmer is moving in an environment charged with new thought expressed in a new phraseology. Science has marched forth from her seclusion in the laboratories of the old world and has laid her invigorating and reforming hand upon the arts, agriculture not excepted. The facts and principles of science underlie much that the tiller of the soil is called upon to consider.

No one will disagree with the assertion, I am sure, that this enlargement of knowledge and methods will be available for use in proportion as it is complimented by an enlarged understanding on the part of the farmer. Just as there can be no sound without an ear to hear or sight without an eye to see, so there can be no appropriation of those facts and principles which are the fruits of study and investigation by those who are both deaf and blind intellectually. We are indifferent to that which we do not comprehend. Let me illustrate:

Several States have recently passed laws for the regulation of the sale of concentrated feeding stuffs. It is provided that no concentrated feeding stuff coming within the legal meaning of the term can be sold unless licensed and especially unless properly marked. The object of such laws is to make it possible for a farmer to know what he is buying and to protect him against fraudulent guarantees.

The efficiency of this legislation rests largely with the consumers of feeding stuffs. If they do not understand its force or are ignorant of its provisions so that they are willing to make their purchases without any reference to the information and the protection that are offered, their lack of intelligence nullifies in part the efforts of the State to defend their individual interests.

The experiment station and the farmers' institute bureau are beneficent institutions, but they are of limited value to those members of our rural communities who have so little knowledge of first principles as to be unable to read and listen with an intelligent appreciation of the facts as presented in bulletins and from the platform.

The agricultural newspaper is not to be ignored as a source of information to our rural people, but it must be read with discrimination. To accept its teachings without close scrutiny on the basis upon which they rest would cause serious mistakes, and how shall the reader always discriminate unless he has some acquaintance with the fundamentals of agricultural science.

Even station bulletins, written by well informed and careful men may be misinterpreted by one who has no adequate comprehension of the significance of such terms, for instance, as protein, carbohydrates, fats.

This brings us directly to the question, How shall farmers generally become properly educated for their calling? And I shall first reply: Their special education should begin with some systematic effort, applied to their early training. It is a mistake to suppose that if the fundamentals of correct thinking in agricultural science are neglected with the youth he will later in his busy years make good all deficiencies through the hit-or-miss opportunities offered by the station bulletin, institute teachings and similar agencies. A few may purchase books and methodically study with some definite purpose in view, but the majority will not do this. Moreover, it is with the young that we should seek to establish a respect for the laws of the material world and a confidence in the utility of science. We should seek to create what may be called a movement of thought which shall bring the individual into harmony with his intellectual and material environment.

When we come to consider the special means for agricultural education your minds doubtless will at once turn to the agricultural department of your State college. You naturally inquire — Have we not provided this college as a place where the future farmers of New York may be given the special training which the times demand? You have, and I can wish nothing better for your State than that this institution shall be crowded beyond the full measure of its resources with those who seek to study science in its relation to agriculture.

But is it not time for us to readjust our views concerning the place the agricultural college is to fill in our educational system? When the Morrill Act of 1862 was passed, men had millenial visions of every farmer hanging a college diploma on the walls of his library which should be the explanation of unheard of triumphs over the soil. But we might as well confess, what we should have known would be the case, that as a direct means of widely educating the rural people the agricultural college is necessarily not available.

First of all, consider the possibilities. President Shurman would be at his wits end if there should go up to him next fall and ask for instruction all the young men of New York who are ready to begin work on the farm. His class-rooms, his teachers, and his resources would be utterly inadequate to meet such a demand. There are about 250,000 farms in your State. In order to place a college graduate on each one it would be necessary for your State college to send out 5,000 men yearly for the next fifty years — a result too improbable to be mentioned seriously. I venture the assertion that no land grant college exists in this country that has sent out an average of one agricultural graduate for each township in its State.

There are other reasons beside the limitations of space and means why not only young men who expect to be farmers do not seek the agricultural college, but especially why many New England farm-bred boys turn to some other than their father's calling, reasons that are not a just cause of reproach to the boys or the farm or the college. Permit me to state some of these in words used on a former occasion:

Those on the one hand who jeer at the college because it has no more agricultural students and on the other hand who reproach farmers and their families because so many country lads seek some other life work than agriculture, are either consumed in their reason by sentiment or prejudice or are shallow in their analysis of the situation.

Our land-grant colleges have accomplished a grand work for agriculture and our rural people by educating leaders, disseminating information and promoting investigation. They have directly and indirectly brought into existence a new literature for the farmer and have aided powerfully in creating confidence in science as a utility. It is time, nevertheless, openly and frankly to acknowledge the fact that notwithstanding their great usefulness these institutions will be the direct means of educating only a small minority of the farmers of any State.

But what about the great majority? Three facts claim our attention in this connection: (1) The farmer sustains intimate and practical relations with the laws and forces of the material world; (2) We are in possession of a fund of knowledge concerning these laws and forces, very incomplete to be sure, but sufficiently definite and extensive to be useful, and (3) much the larger part of the young men who become farmers are to all intents and purposes ignorant of even the simplest principles of what we speak of as agricultural science. This situation is persistently and insistently coming up before us for consideration and the question which presses for answer and which should lie heavily on the conscience of those who determine the educational policy of the State is: How shall it be met?

And the conclusion first to be stated is that the proper education to the rural people must be accomplished by some widespread instructional effort — an effort that shall reach every country school, every grammar school, every high school and every academy to which the sons and daughters of the farm have access. It must be an effort, too, that has behind it the sanction of law and the force of organization. To this matter the leaders in pedagogical thought and the officials of our State departments of public school instruction must give serious attention, not to hide behind the difficulties and dogmatically declare that we are doing as well as we can and that the old is good enough, but to devise means and methods for bringing the subjects to be taught and the equipment of the teacher into line with the knowledge and conditions of today. Just here we are met by several objections.

We are told that the present curriculum of studies is already overcrowded and that fewer rather than more subjects should be considered. Probably this view is correct. It is useless to expect the public schools to find a place for all branches of learning. All that can be done is to select for those young people whose school education will end with the high school or academy, or possibly at a lower point, the subjects most important to the common affairs of life. It is generally conceded that every child should be taught to speak correctly, read and write his mother language, to master numbers so far as necessary for ordinary business, to know the simple facts of geography and only the simple ones, and to understand the fundamentals of government and the essential duties of citizenship. Beyond this the studies should be those which best fit the person to comprehend and control his environment. Can there be any doubt as to what these are for the rural people?

Are not the intricacies of the soil more important than those of advanced mathematics? Will aptness in grammatical analysis make up for an insight into the wonders of plant life? Is the ability to draw an accurate map of one's own State more important than some knowledge of the position of the organs of the animal body and their functions? While the facts of man's history are useful and inspiring, does not the farmer also need to know the life history of the species of plants and insects that are either beneficial or injurious? There is culture and refinement in becoming familiar with the great thought of literature but shall the farmer gain a greater uplift of mind and heart and a greater blessing in his life work, from these than from the thoughts of the Creator as read from Nature's page?

Doubtless those who magnify the utilitarian side of school training will be accused of catering to the commercial spirit of the present time and of degrading education to the dollar standard. It is unfair so to characterize the study of science. To be sure science is useful and why should it not be? Men must live and it is better and easier to live in harmony with law. Besides, study with utilitarian ends in view may also lend itself to mental culture and refinement of thought.

But right here comes another objection. We are told that the present most prominent subjects of study are the ones best adapted to the development of the intellect — that no such efficient pedagogical instruments can be substituted for them. It is also impressed upon us that the chief end to be accomplished is the training of the mind. But our intellectual salvation does not rest with a few out of the many departments of knowledge which are important. Any dignified subject, organized into logical relations and severely pursued may be the means of intellectual culture. Language and numbers are not our only resources for mental training. Rightly presented the complex problems of chemistry, or of physics and the wonderful lessons of biology have in them great training value.

No man is wise enough to divide the field of human knowledge into the useful and the useless for intellectual culture. On what tables of stone has the Almighty written the commandments of education that they may not be changed, and where are the prophets who have stood in the mount of inspiration and delivered these fiats of omniscience to the people! Let us be rid of the nonsense that as man's range of thought widens and his relations to the material world and to society change he must cling to the same old subjects as a means of mental development.

I more than half suspect that the church is not alone in harboring dogmatism and professionalism. It was not long ago that the department of public instruction in a great State turned a cold shoulder toward a university effort to promote the study of rural science. It is a department which holds in its grip the school experience of thousands of children and by its mechanical and inelastic system and its examinations which are the terror of sensitive young minds, is in danger of defrauding the intellect and draining the vital power of the coming generation. The orthodox brethren of our schools sometimes are as reluctant to recognize new thought as are certain portions of the Presbyterian church to discard those statements of creed which few believe.

We are told that there are no text-books for use in teaching rural science and that these are essential. The answer to this is, that when the commercial opportunity for such books arrives or is ever seen in the distance, they will be forthcoming. There are within my circle of acquaintances several men entirely competent to write primers on the soil, the plant, the animal, bacteriology, insects, milk and its products, and so on, and I feel sure that publishing-houses would render greater service to this day and generation by employing these or other persons to write new school-books on new and living subjects rather than to continue to unnecessarily multiply ways of presenting old subjects.

It is also asserted that the teachers of our country schools are not fitted to teach rural science. Many of them are not, perhaps, and they never will be until such teaching is required. One of our wise men remarked to me not long since, "The only way to do a thing is to do it." I see no reason why a demand for such service might not develop teachers for our high schools and academies at least, who would be competent to instruct in the simpler facts of science in their relation to agriculture and the home. Such instruction would be useful in every calling from the farmer to the lawyer.

If there is a school official in this audience I can imagine him saying, "These views are all very good as a theory, but the speaker does not appreciate some of the practical difficulties in the way of reorganizing public school instruction. He has not had actual experience with untrained teachers, lack of proper text-books, insufficient funds and extreme conservatism. He is like so many who advocate reform, he condemns what exists without offering something better which it is practical to adopt as a substitute."

I am well aware of these obstacles to progress. I am convinced, however, that a beginning can be made in providing school instruction better adapted to the needs of our rural people.

In 1876 I was a teacher of a high school in one of the country villages of Maine. During the winter term there was among the pupils several young men who were a problem to me. They had "ciphered" and studied maps and dissected the English sentence until they were tired of it all. The problem was, What shall be done to employ profitably the time of these restless minds? I solved it in this way: I sent for a dozen copies of Nordhoff's Letters to Young Americans and once a day those big boys and I talked over some of the problems relating to political economy and citizenship, crudely to be sure, but without doubt profitably.

There was in the same school a class of very bright young ladies — objects of special regard on the part of the young college graduate, you cannot doubt. This class gave its chief attention to the Æneid, algebra, geometry, and rhetoric, and there was keen enjoyment for both teacher and pupils in the exercise of the intellect which these students demanded. Unless I am misinformed, no member of this class subsequently pursued a course of study at an academy or college. All the school training these pupils received as a preparation for being wives, home-makers, and mothers was that furnished in this high school, and what was true in this instance is true of hundreds of others. We are all convinced, I am sure, that if physiology sensibly taught, plant life, the chemistry and function of foods, domestic bacteriology and hygiene, the ethics of society and similar subjects had engaged the attention of these young women, their intellectual development and refinement of thought would have suffered no deprivations and their understanding of the duties and responsibilities of life would have been much broader.

There is in the State of New York an academy located in the midst of a rural people which is patronized almost wholly by country boys and girls. Its endowment has been derived largely from contributions made by farmers. Not long since, the principal of this school called upon me with this question: "Is it practicable to introduce into my school the study of science in its relations to rural affairs?" It at once occurred to me, here is an opportunity for the State through some medium or other to make an experiment to determine whether the subjects of modern thought and utility may be made the subjects of modern education. I wish that an object lesson of this kind might be presented not only to the people of New York but to you in New Hampshire and I believe that your State university would find no more profitable opportunity for extension teaching than to undertake the guidance and to some extent the equipment of such an educational effort in some one of the more promising high schools or academies. Somewhere and somehow a beginning must be made and one illustration of successful and popular instruction along the lines which have been indicated would arouse sentiment and be a powerful stimulant toward procuring the organization and means for extending similar courses of study to all the high schools and academies at which country boys and girls seek an education.

I believe that if the attention of the young people could be occupied with subjects of living interest we would hear less complaint of the boys breaking away from school at the earliest possible age. It seems as if the managers of many high schools and academies take more pride in building up efficient college preparatory courses for the few than in meeting the needs of the many. Six lads well fitted for college is a worthy result, but sixty young minds better prepared to meet life intelligently on the farm or in any calling would be a more convincing demonstration of the utility of school education.

The next step, then, which I would see taken in education is a fuller recognition in the schools of those branches of learning through which we come to a larger understanding of ourselves and of the world of matter and force.

It is with more satisfaction than I can express, that as presiding officer of the New York State Dairymen's Association, I have the pleasure of meeting you here at this twenty-fourth annual gathering. Last year, at Cortland, when you did me the honor to elect me president of your honorable association, I said to you that the only way we could hope for a continuation of past success was by united effort. The splendid exhibit of dairy products and dairy utensils which we see in the exhibition hall, shows that faithful and systematic hard work has been done, and, when we meet here, this interested audience of producers and manufacturers of dairy products, gathered together for the opening session, we cannot help but feel that there has been, and is, a united effort to make this meeting a success. We occasionally hear the remark, "What is the use of all this work? I have never seen any benefit come from all these discussions about butter and cheese-making and other kindred dairy topics." This question, I believe, answers itself, and that, as long as there are people who make such remarks there is a necessity of coming together and discussing these questions — in trying thus to educate each producer up to the point of seeing the necessity and economy in getting the most and the best product possible from his animals. If the producer delivers the product to another to manufacture, he must be taught to understand the desirability of having a clean, healthful product, in order to insure satisfactory results in his manufactured goods.

In the past, in many instances, there has been a misapprehension of the true relation of producer and manufacturer; the producer feeling that the maker had no interest in his welfare beyond getting the milk of his dairy into the factory. The farmer thought the maker considered only his own profit from working up the milk, and did not care how the owner of the herd came out. In some instances, I am sorry to say, this has been true, and for that reason the farmer took no pains to have right conditions for production. If these were good, it was more a matter of chance than of good management, for there was no organized system at the farm to have the cow, the utensils, and the milker in a good sanitary condition. Everything done was with the one idea of getting along with as little work as possible, and having the milk pass muster at the receiving stand. On the other hand, the makers only idea was to keep the factory going and have the buyer take his goods at the ruling on the weekly salesday. This system of doing business has been a demoralizing one on both sides and is responsible for very much of the poor butter and cheese which finds its way to the markets and makes lower prices for the whole output. In the last few years a considerable number of the people interested in the question: "How can we make the dairy business more profitable?" have come to believe that there can be no permanent advance toward better methods until there is a more thorough understanding of the underlying principles of the business. This educational work cannot be accomplished unless we are willing to accept the ideas of those who have had opportunities for scientific observation and experiments which we have not had. In other words, we must be possessed of a *teachable* spirit. When a change or reform is advocated in any line of business, the hard thing to overcome is prejudice, and I think this is especially true of dairy work. Too much dairy practice is largely founded on traditions which have been brought down from one generation to another, until what grandfather and grandmother said have come to be held proved facts in the minds of quite a class. We all know how difficult it is for us to accept as true, statements which differ radically from what we have been educated from early childhood to believe. I can imagine what would have happened if I could have had the knowledge and had tried to convince my grandfather that milk soured because of the growth of minute plants, and that most of the changes in milk which we have to meet were brought about by some of those different families of plants. I am inclined to think he would not have accepted it kindly, and what would have been true of him is true of some people to-day. Their practical experience and observation have taught them that a certain line of procedure gives certain results which are satisfactory in case no adverse factor is introduced; but, when the gassy, bad milk finds its way into cans or vats, they have no clear idea of the cause or cure for the conditions which the poor milk produces, and its handling becomes largely a question of luck with them. Sometimes they succeed fairly well but at another time a working of butter fit only for wagon grease or a rotten cheese is the final outcome. Such makers do not know how to change conditions, and thus in that way control their work. Indeed it is only within a very short period that any of us have had any idea of the reason why such marked differences should show themselves when we could see hardly any appreciable variation in conditions.

We often hear it said that knowledge is power, and I think you will agree with me that this remark never applied with greater force than to-day. There has been a feeling with quite a class that this does not apply with equal force in the dairy business that it does in other lines, but I am sure that, with the strong competition of the business world at the present time, the man who does not know every detail of his business cannot hope to succeed. In a recent number of the *Country Gentleman* Prof. Drummond of Scotland, is quoted as saying that unless the Yankee agriculturist gives greater study to his business, defeat is sure to overtake him in his fight for foreign markets. The desire to secure a foreign market for their cheese was the factor that induced the formation of the first dairy association in this State in 1864, afterward known as the American Dairymen's Association. Because some manufacturers at that time were much more successful than others, the idea was advanced that by having a meeting of that kind it would be mutually helpful. The men who brought about the meeting at that time by agitating the question of better goods and how to get them, knew very little about the sharp competition which must be met to-day, but they realized that if we did not improve, other sections would accept the opportunity and they would lose a trade of large value. These meetings were productive of great good, and many makers, through study and the comparing of notes with other makers when they came together, had reached a point where they made an even desirable product through the season, measured by the demands of the market of that day. During all this time our export trade increased quite rapidly, and continued until about 1880, when it reached its highest point, when it gradually went back.

There were two prominent causes that influenced that retrograde movement. The first and most important in the start, was from a large class of manufacturers who had gradually argued themselves up to the point of believing that, because they had succeeded so well, they could lower the quality of their cheese, and that people would buy it just as well. It had become quite popular to skim the night's milk, especially in the fall of the year, as good prices were received for this semi-skim cheese, and, with the butter as an extra product thus increasing the net income. Next came the argument, "If we can do this in the fall, why not through the whole year, and thus make our business more profitable; we can put in a little more moisture and the consumer won't know the difference." During this same time Canada was working to build up her dairy interest, and those at the head were wise enough to see that the opportunities were much better with first-class goods. When New York cheese that was skimmed a little and held some extra moisture came in contact with the well-made, full cream Canadian on the English market, there could be only one result. The Englishman knows a good thing when he sees it, and is always looking for the best, consequently he took the Canadian. This short-sighted policy followed by the New York dairymen gave the Canadian the opportunity, and the result was that, in 1890, only ten years after we were at the top we had lost half of our export trade. Prices declined rapidly, and the outlook for the dairy farmers was not encouraging. During this time some of the thinking men connected with this association were studying the conditions of the business, and their observations convinced them that if something was not done, and that very soon, the dairy interests of New York would be practically destroyed. The result of their thought was the establishment of the State Dairy Commission in 1884. The outcome shows that it was a step in the right direction, and the wonderful increase in the consumption of milk in the cities and villages of the State has proved the wisdom of the work. Encouraged by the progress made in that direction, in 1888 then was brought forward and passed the dairy instruction law, and I wish that it were possible that two of the men that were largely responsible for the passage of that law could come back long enough to see the splendid exhibit of butter and cheese we have here to-day. I am sure they would say we acted wisely at that time. I refer to the late Dairy Commissioner J. K. Brown and the late Col. F. D. Curtis, both of them men who had the best interest of the New York State dairymen at heart. I think many of the dairymen here will be willing to concede that the painstaking work done by M. T. Morgan and the late E. A. Ayers in the first year of the operation of that law had quite a little to do with the present high reputation of Jefferson county cheese.

We have come together to-day to discuss this work and try to find a solution of some of the difficult problems we meet. One question to take up will be, can we improve on the best work done by the up-to-date, careful manufacturer? In some ways I believe we can; in others, perhaps not. Another question is how to bring the whole manufactured product up to the standard of the best. I think you will agree with me that the off-flavored, mushy cheese and the poor skim cheese lessen consumption and tend to lower prices. The poor butter of which there are large quantities yet made, not only lessens consumption, but gives the renovated butter and oleomargarine manufacturers an opportunity which they otherwise would not have to dispose of their products. I have been interviewing some of the retailers in villages where I have been lately, and they tell me that they cannot obtain good butter in quantities sufficient to supply their trade. I asked one man why he did not buy in the New York markets. He said, "If I buy there in sufficient quantities to make the express charges reasonable, the last of it gets stale before I can dispose of it. I have no refrigerator, but a good cellar, and butter which has been kept in cold storage will not keep with me." Now, these are all questions that have to do with putting the dairy business of the State on a profitable, sound basis. I do not expect we can solve *all* of them, but if we can give *some* suggestions whereby less poor butter and cheese will be made the coming year, it will be a gain in the right direction, and will pay for holding this meeting.

Thanks to the work of the scientists who have taken up this dairy question within the last few years, we know very much more about the hard problems to-day than formerly, but there are many questions that are not settled. They have shown that the physical and chemical changes which take place in the milk the first day or two, as to taste and odor, are due to the activity of minute plants, and that of the large number found in the milk, very many of them are useful and only a few make the mischief. They have shown how these hurtful organisms can be counteracted by controlling conditions which are almost wholly *outside* the animal. This is all a great help in enabling us to understand the reason for many of the little things of which it was so hard to find an explanation before. The question of the underlying principles that govern the changes which take place in a cheese during the curing or ripening process, is one on which authorities do not agree. There have been several theories advanced and in a measure refuted, as is often the case in such work. At the present time there is a great deal of careful work being done, and it is hoped that in the end they will be able to determine the true facts governing it. The question of the laws governing the development of flavors is probably least understood. Certain germs have been isolated and cultures made which have helped in producing the desired flavors in butter and cheese, and some of the bad flavors have been traced to putrefactive germs, but the underlying principle which brings about all the different flavors is not well understood.

Prof. Harding, bacteriologist at the Geneva Experiment Station, has been working for the last eighteen months on the causes which produce sweet flavor in cheese. He has had a large number of samples from different sections of the State and has made cultures from them from which he has isolated certain yeast plants and cultivated them. He has put one of those cultures in milk and I have made cheese from it. In some instances I had the sweet flavor develop in the cheese to quite an extent. In others I failed, showing that we failed to secure some of the particular conditions it required to do its work. If Prof. Harding is able to work out the conditions which this yeast requires in order to produce its characteristic flavor, then we shall know how to control it and thus stop the loss from that cause, which is a large item to the dairymen in many sections of the State. I believe he has good prospects of accomplishing the desired end.

The question which is easiest to study of the whole line of cheese investigations, because it does not require the aid of a scientist, is about the last to receive any attention, and that is the effect of temperature in curing the cheese. I do not think there has been any systematic effort in that direction until the last two or three years. Wisconsin and Canada have both been working on this question lately and have secured quite convincing results. At the meeting at Cortland last year I told you something about the work we were doing at Geneva and the results we had been able to secure up to that time. We have continued the work and the results this year are even more convincing, if possible, than those previously obtained. In discussing this work I shall confine myself to the question of quality, and will use to illustrate it a number of day's cheese which were made the last of July and the first of August. This is a time of year I think you will allow which is as bad as could be selected for climatic conditions. This year, as we all know, it was especially bad, being very hot and dry. There were six cheeses made each day and one placed in each room, the rooms being kept at temperatures of 80°, 75°, 70°, 65°, 60°, or 55° F. The cheesees made on July 27th were sent to New York on September 1st and scored by a member of the firm of a prominent cheese commission house. The scoring returned by him on that lot was in 80° temperature, 42 flavor on basis of 50 perfect, 21 texture on basis of 25 perfect. The 75° rooms, 43 F., 23 T.; the 70° room, 45 F., 23 T.; the 65° room, 47 F., 24 T.; the 60° room, 48 F., 25 T.; the 55° room, 45 F., 25 T. The last cheese reported a little sharp, unpleasant flavor. The real trouble was, it had not fully matured at the low temperature. On October 1st cheesees made on July 30th were sent and the scoring returned was for the 80° room, 42 F., 21 T.; the 75° room, 43 F., 22 T.; the 70° room, 43 F., 22 T.; the 65° room, 48 F., 24 T.; the 60° room, 49 F., 24 T., and the 55° room 49 F., 24 T. On November 1st the cheeses made August 1st were sent and the scoring returned was for the 80° room, 39 F., 20 T.; the 75° room, 41 F., 20 T.; the 70° room, 43 F., 22 T.; the 65° room, 44 F., 24 T.; the 60° room, 47 F., 24 T., and the 55° room, 47 F., 24 T. The gentleman said in addition that it did not seem possible that the cheese originally all came from the same vat, and that the curing could make such a difference, the last three being very good cheeses and the first three nearly spoiled.

I think you will agree with me that the two most important factors in a first-class cheese, one that can be depended upon to please the customer every time, are first, flavor, and second, texture. If the color is not just perfect the buyer may cut the price, but the consumer does not mind that part if it only tastes good. We might say from the consumer's standpoint that flavor is the one thing necessary, but in order to be sure of the good taste there must be no free moisture and that means fairly good texture. We often hear a person say I like a moist cheese, and such cheese may be especially good at just the right point, but, like a ripe pear, it deteriorates very quickly, and for that reason it is not wise to try to cater to that taste. Good, sound cheese that are thoroughly ripened at a temperature not far from 60° F., as shown by our experience of the last two years, is the kind we should put on the market. It is the kind that will increase home consumption so rapidly that in a short time we shall not hear anything about that surplus of milk and consequent low price in summer. To bring about this very desirable condition will necessitate some radical changes in methods of doing business. Working at every point to see how cheaply a thing can be done without regard to the resulting product, must be stopped, as it is the prime cause of very much of the poor butter and cheese. In those cases where the farmer is educated up to the necessity of keeping everything about his dairy in good sanitary condition, and takes the milk to a cheese-maker who is up-to-date in his methods of handling the milk and manufacturing the cheese, I doubt whether there can be very much improvement, except in this way. The scientist by finding how adverse conditions can be better controlled, and by putting the producer in a way to understand facts which at the present time are not well understood, may help him to make a more uniform product. Where the radical change must come, if the facts as shown by our work at the Geneva station prove true in commercial work, and there is no possible reason why they should not that I can see, is in a better control of temperature in the curing-rooms. The temperature in most cheese factory curing-rooms follows outside conditions very closely, and during the hot summer months the cheeses are exposed to a range of anywhere from 70° to 90° F. You will rememer that our experience was that all the cheese in the experiment at the Station, when the temperature was 70° F. and above, did not hold their flavor. I expect that quite a good many people will say, you might obtain the results you report in the small way you have been working, but it is not practical for commercial purposes. To meet this objection and do it in a way to give everyone an opportunity to study its workings, I believe the only way is to ask the legislature of the State to give the Commissioner of Agriculture a sum of money sufficient to test this work in a commercial way. I shall not take the time to formulate a plan for doing the work, but if it meets with your approval I hope a suitable resolution will be introduced and passed before we adjourn, asking the legislature to provide the necessary funds to prove the advisability of this work.

We must not expect to work radical reforms in one year, and I am so thoroughly convinced of the practicability of this work that I believe the sooner we begin the agitation of the question the better it will be for the dairy interests of the State.

The Silo and the Material to Fill It.

By Prof. I. P. Roberts, Dean of College of Agriculture of Cornell University.

Read at meeting of New York State Dairymen's Association at Watertown.

It is now about twenty years since the practice of ensilaging cattle foods attracted wide attention in the United States. The crude method of storing green material in shallow excavations in the earth, formerly practiced in France and Germany, has been greatly improved in the United States. The practice of ensilaging green material was introduced with a great flourish of trumpets. Few knew anything of the true principles of the subject, therefore any one could propound theories without the slightest danger of being successfully contradicted. The first siloes built were usually tall, oblong stone or brick structures, partly or entirely above ground. In the early days it was believed that silage could not be well kept, except it was placed under great pressure. The winter's concentrated feeding stuffs, cord wood, stones, earth, and even pig iron, were placed on the covered material to weight it down. In a few cases expensive screws were brought into use to secure pressure, but with all this pressure, the silage was usually unsatisfactory, for no amount of pressure could force the locked-up air out of the material. The more the material was pressed, the more did the air tend toward the cold masoned walls, where in time, it ascended and carried with it the moisture of the silage, and by reason of this partial drying at the corners and on the edges, opportunity was afforded for air to circulate somewhat freely along the walls to the great detriment of the silage. These unsatisfactory structures were soon supplanted by oblong, thribble-boarded ones, which proved to be nearly as expensive as the stone or brick structures, and far more perishable, although this resulted in an improved quality of silage. As the silage deteriorated most in the corners, the practice of cutting the corners off came into vogue. Still the material of which the silo was constructed decayed rapidly, and moldy silage was found too often next to the wall. The octagon silo supplanted the one with square corners and was an improvement. Next followed the round structure, thribble-boarded silo, two layers of matched boards separated by tarred building paper were placed on the inside, and one thickness of similar boarding on the outside, these boards being bent and fastened to the heavy frame work, securely bound the silo together, and the danger from cracks in the walls of the structure was entirely obviated. Who first conceived the idea of constructing a silo on the principles embodied in water tanks, I do not know. The first stave siloes built were patterned almost exactly after the large water tanks of the railroad companies, except the bottom was left out. These were not fully satisfactory, because high-priced material had to be used, and because when the hoops were tightened there was danger of their breaking, by reason of the expansion of the staves, and there was little or no "give" in the staves because their edges were so boveled as to press alike, when the staves swelled, on their inside and outside edges. Who modified the stave or tub silo so as to better adapt it to its new uses, I do not know. In any case, somebody discovered the true principle of preparing the staves simultaneously with the manufacturers of water tanks. I refer more particularly to smallish tanks used in the top story of barns and other buildings for the storage of water. This principle is very simple, and the only wonder is that it had not long since been put to use in the construction of water tubs of various kinds, and silos as well. This principle consists first in securing a rough or sawed edge on the edge of the staves, with no bevel or one so slight as to result in causing the inner edges of the staves to meet before the outer edges. By this method but a small portion of the edges of the staves come in contact, and when they are pressed together by tightening the hoops or by the expansion of the staves from moisture, they crush together and form water-tight joints. I think it unnecessary to lay stress upon the fact that a water-tight tub silo is not necessarily an air-tight one, because I think we will all be fully satisfied with a silo tight enough to hold water.

Neither modern silos built of brick or stone, or wooden ones lined with brick, even if they receive a coat of plaster on the inside, are air-tight, it is only when such structures are treated with a coat of glazing that they become so. Time will reveal whether it is best to construct water-tight silos of wood, or air-tight ones at an expense three to four times greater than the wooden structure. Since the air pressure in the silo is outward and not from without inward, we need not concern ourselves greatly if the silo is water-tight. Is the stave silo water-tight when properly constructed? We have used several stave water tanks constructed on the principles of beveling the staves, so that when set up and hooped, the edges of the staves touched only about one-third of their width. As the hoops on these structures are tightened, the inside edges of the staves are crushed and made water-tight. In order to prove that the farmer could construct water-tight silos, we had staves prepared with unbeveled, sawed edges. These when set up were hooped with the ordinary silo hoop of commerce. This tub was placed on a temporary wooden bottom, and so treated that a water-tight joint was secured where the ends of the staves joined the bottom. This small silo of four feet diameter and four feet high was filled with water, and it proved to be water-tight from the first. It was left out in the open during the entire summer, some times full of water, some times nearly empty, and yet it never leaked when refilled, although for a part of the time there were but two hoops on it, and although the staves were but two inches wide. From this and other experiments, I conclude that if fairly well seasoned, sound timber is passed through the saw to secure rough, straight edges, and a uniform width of stave, a water-tight silo may be secured, provided that in the large silo the edges of the staves are not beveled, and in small ones, beveled slightly. My judgment is that few silos with air-tight walls will ever be constructed, for if they are virtually water-tight, reasonably durable and cheap, the practical limit of perfection will have been reached.

As yet we have not had sufficient experience to determine whether bands of woven wire fencing or round hoops are the best. Either kind is good. I think all will agree that some loss of dry matter occurs whether roughage is left in the field for a time and then put under cover, or placed while green in the silo. Which treatment results in the least loss has not been definitely determined, and probably never will be, since the conditions in the silo or in the field are not alike from year to year, and it has not yet been determined what kind of a silo preserves green material best. Some investigations in an Experiment Station indicated that greater losses occurred in the stave silo than in another constructed on a different principle, but there is no data showing that the stave silo used, was well-built and water-tight, except at the doors.

More attention should be given to the condition of the material when ensilaged, and of the methods employed in preparing it, and in filling the silo and sealing it. The sealing material is usually not deep enough nor is it kept as wet as it should be. Just here is room for improvement.

As yet we have discovered but one plant that is eminently productive in universal culture, easily raised, acceptable to the animals, cheaply harvested and ensilaged, coupled with good keeping qualities — Indian corn.

Maize is pre-eminently a sun plant and therefore should be grown under conditions which harmonize with its inherited characteristics. A large yield is desired, therefore as large varieties should be grown as will reach a fair degree of maturity in the locality where produced. Varieties producing abundant leaves and not too large stalks should be selected, because leaves are more acceptable than stalks, and since the grain is more acceptable than stalks or leaves, the variety should be prolific. It should be planted thin enough to secure a goodly quantity of ears, and should be early enough to permit the most forward ears to become glazed before frost appears. Having selected varieties well adapted to soil and climate, much attention should be given to the preparation of the land and to subsequent introculture. The soil is often too moist and cold in the spring for maize to start vigorously. Then it stands to reason that the land should be loose and light, not compact and sad at time of planting. Corn ground is more often over than under prepared. One cultivation may be given after the corn is planted and before it comes up. If this cultivation be rather deep it will tend to warm and dry the land. The harrow may also be used after the cultivator and before the corn is through the ground, as well as afterward. Much depends on the character of the soil as to the after methods of tillage. In light soils the harrow may be used to more advantage than in heavy ones. On cold and heavy lands the roots form nearer to the surface than they do on warm soils. This distance between the stalks in the rows, and the intervals between the rows, are governed somewhat by the variety of corn, the fertility of the land, and the moisture holding capacity of the soil. Good judgment and the faculty of adapting means to ends are always required. Silage is not an ideal cattle food as now prepared, but when all the pros and cons are considered, from the grain of corn in the ground to the milk in the pail, the conclusion is reached that silage has come to stay, notwithstanding it is not an ideal cattle food, and that it will continue to be in the future, as in the past, a great boon to the dairyman and the stock-raiser.

I have written this simple paper, not so much to instruct this intelligent audience, as to place in a permanent form what appears to me to be fundamental principles, that future generations may know how the practice of ensilaging green material was looked upon at the end of the nineteenth century.

The Progress of Dairy Farming in Canada.

By Prof. JAMES ROBERTSON, Commissioner of Agriculture for Canada.

Delivered at meeting of New York State Dairymen's Association at Watertown.

I desire to congratulate the dairymen of the country on the progress which has been made in the industry with which they are connected. I offer my best wishes to the New York State Dairymen's Association for still larger success than has followed its efforts in the past. These as we all know, have been characterized by intelligence, practical ability, and co-operation.

There is room for both extension and improvement in every sense in the dairy farming of Canada. At the beginning of the nineteenth century there was not so many people in the United States as there are in Canada at the opening of the twentieth. There does not appear to be any good reason why the growth of Canada in material wealth, population, and influence should not be even greater during the next hundred years than it has been in the great country to the south of us during the century which has just closed. We have more power and resources at our command than were available to any of the peoples at the beginning of the last century. We have still vast areas of unoccupied fertile land, and as everybody admits, we have greater natural resources, still largely undeveloped, than have ever before been in the possession of a country of about 6,000,000 of people.

CAPACITY OF CANADA FOR PRODUCTION.

In Canada, the soil, the climate, and the intelligence and industry of the people are favorable for the production of a great variety of food products of exceptionally fine qualities from farms, gardens, orchards, and vineyards; and the extensive sea coasts, vast lakes, rivers, and streams abound with the finest of fish. From its geographical position, its railway systems and unsurpassed steamship service for freight across the Atlantic, the export trade in food products can be greatly extended with European countries to the mutual benefit of Canada and the countries which purchase from her.

The production of foods is the main aim of farming operations; and over 45 per cent. of the population of Canada are engaged in agricultural occupations. There are vast areas of fertile soil from the Atlantic to the Pacific oceans, and the climate or climates range from subtropical to subartic, with a rainfall varying from sixty-seven inches per annum in British Columbia, seventeen inches in Manitoba, to from thirty to forty-five inches in the Provinces of Ontario, Quebec, New Brunswick, Nova Scotia, and Prince Edward Island. The mainland practically lies between 60° W. longitude and 125° W. longitude. The distance across Canada from east to west is rather more than one-sixth of the distance around the earth at that latitude. It extends from a little south of 42° N. latitude to the arctic regions. France lies between 42° N. latitude and 51° N. latitude, which corresponds to the latitude of the settled portions of Canada. For instance, Toronto lies in latitude 43° 39′ N., and Cannes, in the south of France, in latitude 43° 34′ N. Winnipeg, in the Province of Manitoba, lies in latitude 49° 50′ N., and Havre, on the north coast of France, in latitude 49° 29′ N. However the climate on the whole is warmer in summer and colder in winter than in corresponding latitudes in Europe.

Canada lies in latitudes similar to those of the great countries whose peoples are foremost in the world's affairs. It has a land surface nearly twenty-nine times larger than Great Britain and Ireland, or seventeen times larger than France. If the area of the whole of Europe be represented by twelve, then the area of Canada would be eleven. Of course large tracts in the northern arctic regions are uninhabitable and entirely useless for the production of foods; but across the continent, there is a zone about 3,500 miles long, and nearly as wide as France, with a climate adapted to the production of foods of a superior quality. Within that belt there are some mountainous regions and a few hundred miles of arid prairies, where the settlement will always be sparse and the production of foods scanty.

These comparisons indicate roughly the enormous capacity of Canada for the production of foods. In places which are now cultivated the soil has been found fertile. The freezing of the soil in winter, which at first sight seems a drawback, retains the soluble nitrates which might otherwise be drained out.

By competent authorities in England it has been estimated that the drainage in that country from November to March, carries off to the sea a quantity of nitrates per acre sufficient for an average crop of wheat.

To cite one instance in the Province of Ontario, the average yield of fall wheat for five years in the whole province is reported as 20.5 bushels per acre, and of oats, 34.5 bushels per acre.

PROGRESS IN CANADA.

These natural resources have always been with us, and whatever of progress has come has been due to the labors and intelligence of a thrifty people. The difficulties in the way of successful farming become greater and more numerous every year. These are chiefly difficulties to be successfully overcome by good management; and as the difficulties increase, so does the need for enlarged knowledge and greater ability. Let me cite one instance of increasing difficulties.

When dairy farming was begun in some parts of the Northwest Territories about six years ago, we received the cream from one farmer delivered in a fine, sweet condition, every fifth day during the summer time. With even greater care in cooling and cleanliness, cream from the same farm can now, with difficulty, be delivered in sweet condition every second or third day. The multiplication of bacterial forms of life causes the milk to sour more quickly. So it is throughout the whole range of farming operations. Insect pests and weed pests, diseases of plants, and partial exhaustion of the soil, are all serious difficulties which have to be faced with increased intelligence and organized effort. The history of the development of dairying in Canada illustrates some of the excellent results which can be obtained from intelligent organized effort. Organization is useful to bring about economical ways of doing things; and such a subdivision of properly correlated labor as to obtain the very best results in products, in profits, and in increased ability on the part of the workers and the managers.

HELP FROM GOVERNMENT SOURCES.

Forms of help which a government may with safety and benefit give to people like Canadians are quite limited in their character, although they may be applied in hundreds of various ways. I think it was James Russell Lowell who said of those restlessly energetic people who live to the south of us: "Every man is as lazy as he dares to be." If such a statement as that be true concerning the people who live on this continent, then the getting of something for nothing will likely be more mischievous than wholesome. But those forms of help which increase the intelligence of the people, cause them to develop ability in the carrying on of their own work, and promote co-operation among the farmers themselves, as well as between the farmers and the government, are good, and good only. Such is the help which Provincial and Dominion Governments have extended to the dairy business. A few instances may be cited to illustrate the success of that policy.

THE CHEESE TRADE.

In 1880, the exports of cheese from the United States to foreign countries were rather more than three times larger than from Canada. By 1890, the exports of cheese from Canada were about equal to those from the United States. By 1898, the exports of cheese from Canada were three times larger than those from the United States. The following figures show the growth of increase in the value of exports of cheese from Canada:

	1880.	1890.	1900.
Cheese exported	$3,893,366	$9,372,212	$19,856,324

In 1886, when the governments first began to give systematized educational help to the dairymen of this country, the exports of cheese from Canada were 78,112,927 pounds, valued at $6,754,626, whereas in last year (1899) we find that the exports of cheese were 189,827,839 pounds, worth $16,776,765, showing a very decided growth. At least a large part of that growth was due to the systematic, well-organized and well-directed efforts of different agencies, not only of the Dominion Government but of the Provincial Governments, dairymen's associations, and boards of trade. During the period from 1886 to 1899, the British imports of cheese increased 34 per cent., whereas Canadian exports increased 143 per cent. That indicates something of what may be gained by systematic, competent, and authoritative direction, because the government did not give any bonus assistance.

THE BUTTER TRADE.

The development of the export trade in butter has been rapid and marked, since cold storage was provided for the safe carriage of butter on ocean steamships. The increase in value of the exports is shown in the following table:

Butter exported:

Year.	Value.	Year.	Value.
1895........	$697,476	1898........	$2,046,686
1896........	1,052,089	1899........	3,700,873
1897........	2,089,173	1900........	5,122,556

In passing, let me say also that the increase in the whole Dominion during that period, between 1891 and 1899, in the number of creameries and cheese factories, has been from 1,733 in 1891, to 3,649 in 1899. The increase in the various provinces has been as follows:

	1891.	1899.	
Maritime provinces	28	177	Cheese factories and creameries.
Ontario	938	1,469	Cheese factories and creameries.
Quebec	728	1,596	Cheese factories and creameries.
Quebec (combined butter and cheese)	——	307	Cheese factories and creameries.
Manitoba	31	64	Cheese factories and creameries.
Northwest Territories	7	32	Cheese factories and creameries.
British Columbia	1	4	Cheese factories and creameries.

THE BACON TRADE.

The bacon trade, which also is a branch of dairy farming, has been developed very greatly in recent years.

The growth of the export trade in bacon is shown by the following table:

Bacon, hams, and pork exported —

1896.	1897.	1898.	1899.	1900.
$4,446,884	$5,871,988	$8,092,930	$10,473,211	$12,803,034

Canadian hogs are fed, as a rule, in a cleanly way. They are fed on feeds suited for the production of what are known as fleshy sides. Bacon with an excess of fat is not wanted except in the lumber camps. Consequently the farmers of Canada have been going into the breeding and rearing of a class of swine suited for the production of bacon, having plenty of lean and firm flesh. The great extension of the dairy business of Canada has fitted in with the rearing of large numbers of swine. Skim-milk and whey are feeds suited for the feeding of swine. Experimental work has shown that swine fattened with part of a ration of skim-milk, were lustier, more vigorous, and of a more healthy appearance than swine fatted wholly on a ration of grain. Whey is also a valuable feed for swine. There are about seven pounds of solids in every hundred pounds, and that quantity of whey fed properly in combination with other feeds, has produced two pounds of increase in the live-weight of swine. The feeding of meals from a mixture of cereals, such as oats, barley, peas, rye, and Indian corn, has resulted in a fine quality of swine products at the least cost per pound of production.

The export commerce of the country in most of the farm products is increasing at a very rapid rate. The following comparative statement of the value of the exports of some of the farm products of Canada, during the years 1896 to 1900, shows the growth in that short period and indicates something of the great possibility for further expansion of this trade:

VALUE OF SOME FARM PRODUCTS EXPORTED IN YEARS 1896 AND 1900.

(Years ending June 30.)

	1896.	1900.
Wheat	$5,771,521	$11,995,488
Flour	718,433	2,791,885
Oats	273,861	2,143,179
Oatmeal	364,855	474,991
Peas	1,299,491	2,145,471
Cattle	7,082,542	9,080,776
Cheese	13,956,571	19,856,324
Butter	1,052,089	5,122,156
Pork, bacon and hams	4,446,884	12,803,034
Eggs	807,086	1,457,902
	$35,773,133	$67,871,206

EDUCATIONAL AGENCIES.

These notable increases and developments appear to be only the beginning of what may be continued at an equal rate for many years to come. The great departments of activity within the nation are becoming better correlated to one another. The efficiency of each is being improved with decided advantage to all. So far as the Department of Agriculture is connected with these, they may be mentioned as the production, transportation, distribution, legislation, and education. The main aims of education, on the side of it which looks out towards and leads out to material progress, are to develop intelligence, enlarge practical ability, and promote co-operation.

Mention should not be omitted here of the actual steps which have been taken by a great many different agencies in helping on the great national movement for the improvement of agriculture in general, and dairy farming in particular. The first Dairymen's Association of Ontario was formed in 1867. It and the others which have been organized since, have diffused information in an attractive and effective way. These associations have brought to the front men who have been worthy leaders and who have been successful in leadership from personal ability, and from liking the people whom they sought to help. A great factor in the progress of dairy farming has also been the commercial talent of the men who have purchased the products and exported them to Great Britain. These men have passed on to the manufacturers and the farmers who supplied the milk, information of a directly helpful sort. Then the exhibitions, travelling dairy instructors, dairy schools, illustration dairy stations, and bulletins, have all been agencies contributing their quota of assistance. The bulletins published by the different Departments of Agriculture, the newspapers, and the agricultural papers, have been powers for good among the people in connection with this work. These are sowers of seeds, seeds that spring up, seeds of opinions only in many cases, but seeds from which have risen the opinions of the people; and these have had a marked effect on their attitude, on their character, and on the ideals toward which they have striven and are still striving. As one instance of the particular value of good illustration work in dairy farming, let me cite a case from the beginnings of co-operative dairy farming in Prince Edward Island. In 1892, one illustration dairy station was started by the Dominion Department of Agriculture. Part of the cheese from it was exported to Great Britain, of which part was sold for fifty-six shillings and sixpence per hundredweight. Ordinary finest quality cheese from Canada at that time was selling at fifty-six shillings per hundredweight. That sixpence per hundredweight additional put new hope into the then-and-future dairy farmers in that province. The sixpence extra brought hopefulness, confidence in their own ability, and enthusiasm.

The exports of cheese from Prince Edward Island in 1900, were over one hundred times larger than in 1892. These educational agencies are affecting the practice of dairy farmers in all parts of their work. They are bringing about a better understanding of soil, plants, animals, and products, and how to manage these to get the best results from each in proper relation to the others. To most dairy farmers now, the cultivation of the soil has a meaning much clearer than it had in former years. It is perceived now that cultivation is a means toward providing seed bed, suitable for the particular crop to be grown.

PURPOSE OF CULTIVATION.

Cultivation is not only to make a suitable seed-bed for the root-hold of the plants; it is to kill weeds which are the great thieves of plant food and mainly the thieves of the water, which they evaporate into the atmosphere. Surface cultivation keeps the moisture near the roots of the plants. Experiments at the Experiment Station at Michigan, show that frequent cultivation between rows of Indian corn made a difference of 86 per cent. in the yield over the uncultivated. Frequent cultivation gave an increase of 17 per cent. over partial infrequent cultivation. Surface cultivation makes a loose mulch of soil which arrests the capillary movement of the water from beneath, and leaves it available to the roots. For nearly all the crops, the ideal method of surface cultivation is to roll the land after they are put in (that makes the soil warmer), and then immediately before the plants are up or after they are a few inches high, to harrow it lightly to make a surface mulch (that makes the soil moisture available and prevents drying and cooling the soil by rapid evaporation until it is shaded by the crop). All matter taken up by the roots of the plants is taken in solution. It has been estimated that for every ton of dry matter which a crop contains it has thrown off through its leaves not less than 300 tons of water in its growing. Then there is the solvent action of juice from the roots of the plants. Exudations from the roots touch mineral matters and dissolving them make them available for the rootlets to take up.

It is a means of promoting the activity of forms of bacterial life which are helpful to the growth of crops, and is a means of conserving moisture, the proper supply of which in a large measure determines the abundance or bareness of the yield. I remember the time when at least one lad, harrowing with a pair of colts, knew no more than that harrowing was to get over the largest possible area of ground and to raise as much dust as possible. There are older men still in many walks of life who do not discern that men in harrowing should always have an eye toward the harvest and not toward raising dust.

THE ROTATION OF CROPS.

The productiveness of the soil depends upon the substances present in the soil, and still more on the condition of the substances as to availability. That is where and how the rotation of crops comes in, and can be of very great benefit to the farmer who understands the underlying principle, or at least follows the practice. Some crops by growing on land not merely give a good return in themselves, but they make available in the soil, the plant-food that the succeeding or some succeeding crop needs and can get in better form through their action.

It is admitted that the rotation of crops has been the chief means of improving the agriculture of Great Britain and some other parts of Europe during the century. The practice itself consists in growing roots (or some other cultivated green crop), and leguminous crops (such as clover, beans or peas), or grass (or hay crops), alternately with cereal crops ripened for grain. The famous four-course Norfolk rotation was roots, barley, clover, or beans and wheat. The chief point seems to be to make those crops follow each other which have different requirements, as to the time of the season when they benefit most by plenty of available plant-food in the soil and different habits of growth in other respects, particularly in the range of their roots. The rotation for any farm must have regard to the soil, the climate, the markets for rotation crops, and other local conditions. Not only the increase in the yield of crops has to be taken into account, but also the value and uses to which the crops can be put when grown. It is for everyone to determine what crops he can raise and sell at a profit, and then to plan a rotation to give each of those crops the best possible chance to yield largely.

THE ROTHAMSTED EXPERIMENTS.

At the Rothamsted Experiment Station, England, which I think is the foremost in the world for thoroughness, reliability, and comprehensiveness of work with farm crops, a series of experiments was begun in 1848, and has been carried on continuously since that time, to discover the results from growing crops on the same land continuously without and with manure, and from growing similar crops in rotation without and with manure. The rotation was the four-course one of turnips, barley, clover (or beans), or fallow, and wheat. Without going into the details of the experiments and the records as published, I desire to present the following table which I have arranged from the reports of eight courses, 32 years (1852–1883). The results from the continuously-grown crops relate to the produce of the same eight seasons as those in which the rotation crops were obtained. The unmanured and superphosphate conditions were the same in both cases. In the case of the mixed manure results, it is to be observed that in the rotation experiments, a quantity of manure was applied for the turnip crops only, which was to carry the whole of the crops of the four-years' course; whilst in the continuous-crop experiments, the quantity of nitrogen which was supplied each year amounted to rather more than one-fourth of that applied for four years in the rotation experiments.

ROTATION *versus* CONTINUOUS.

Average quantities of dry matter per acre in wheat and barley grown in rotation, compared with those grown continuously:

	Unmanured and superphosphate only		Mixed manure.	
	Grain.	Straw.	Grain.	Straw.
	Lb.	Lb.	Lb.	Lb.
Wheat, rotation	1,515	2,585	1,694	3,188
Wheat, continuous	706	1,143	1,238	2,142
Percentage increase....	114	126	36	48
Barley, rotation	1,452	1,549	2,109	2,368
Barley, continuous	1,001	1,000	2,298	2,489
Percentage increase...	45	55	.....	.....
Percentage decrease ..	.....	.....	8	5

I shall present also the results from an experiment conducted at the Purdue University Experiment Station, Indiana. The object of the experiment was to ascertain the effects on soil and crops of different systems of cropping without the addition of manures or fertilizers. One series of plots was devoted to *continuous* grain growing, the *same* crop being grown every year on one part of the series, and *two* grain crops alternating with each other on another part. On another series of plots three different *rotations* were followed, each one of which included wheat. The following table shows the average yields per acre in bushels for the seven years, 1887 to 1893:

	Bushels per acre.
Wheat, rotation	21.61
Wheat, grain only	15.89
Increase	5.72

This shows that wheat grown in rotation with other grain and grass crops has yielded 36 per cent. more on an average, than when grown continuously on the same soil or in alternation with another grain crop.

SUMMARY OF BENEFITS.

The great increase in crops grown in rotation over those grown continuously, seems to be because more nitrogen is available to the former; and perhaps because it is available during the early period of their growth, from the preparation of it by the preceding crop or by the cultivation of that crop. Other benefits from systematic rotation of crops are (1) the distribution of the mechanical operations of the farm over the season; (2) the opportunity for cleaning the land; (3) the comparative freedom from damage by insects, and (4) the production of a variety of products for feeding to live-stock and for sale.

THE TWO PROCESSES OF INCREASE.

In the growth of all plants that form farm crops there seem to be two processes that govern the increase, and the understanding of the principles of these will, I think, help any farmer and every farmer to form rotations for himself that will be exceedingly valuable, whilst without an understanding of these principles he will be always groping in the dark after the best methods. In the growth of plants one set of conditions make for increase in the size of the roots and the stems and the leaves. These are the vegetative part — the part of a plant that perishes utterly when the plant dies. There is another part of the plant that does not perish when the growth ends, viz.: the seed that carries the life over to the next crop. The conditions which make for the enlargement of the roots and the stems and the leaves, do not make for increased production of seeds. That is to say, the conditions most favorable to the vegetative processes of the plant are not favorable to the maturing processes, but are almost the opposite. If you will allow me a parenthesis: The understanding of that principle, with the selection of seeds, will do more to improve farming in Canada than anything else I know of in regard to agriculture. The set of conditions favorable for continued increase in size of root and size of stem and size of leaf do not make for increase in the quantity of seeds, but rather for the opposite. The extension of the vegetative stages of development — the formation of roots, stems, and leaves — is at the expense of the development of the reproductive parts — the seeds. Take the instance of a bunch of oats growing in a dung hill; what happens? A very large root, a grossly large stem, broad, long leaves, and very, very, very few seeds in the head. That is to say, the conditions that make for the continued enlargement of the root, the increase of the stem, and extension of the leaf do not make for an increase in number and weight of the seeds. That is an extreme case, but it reveals a principle. Now, take another set of extreme conditions, where a plant can grow only with difficulty, either in root, or stem, or leaf. Look on a bare roadside, where a small grass plant tries to form seeds when only three or four inches high; then count the percentage of weight of the whole plant made up of the seeds, and you have a revelation on the other side. The conditions that make it difficult for a plant to grow a larger root and a larger stem and larger leaves after the time of ripening has come, make for the increase of the number of seeds and the increase of the proportion of weight they bear to that of the whole plant. Of course, the conditions that make for the increase of size of root and size of stalk and size of leaf up to a certain point, also make for the increase of seeds, because the seeds are formed out of what the plant takes in through its leaves and roots. But when there is an excess of available plant food in the soil, only late in the growing and maturing period of the plant, that may prevent seeds from forming plentifully and ripening thoroughly. That is what happens frequently when farmyard manure is ploughed in, in the spring, for a grain crop in Canada.

In some plants the farmer wants a large root and large stem and large leaf, and in others he wants only the seeds — the other parts being an unimportant and secondary consideration. An abundance of plant food, an excess of it if you will, early in the life of the plant, makes for the growth of roots, and stem, and leaves; and then after the plant is about full size, some difficulty in getting more of it, makes for the growth of seeds. If a man wants large turnips let him pile on the manure. You never saw too much manure on a turnip field, for the size of the turnips. That is quite unlike the bunch of oats on the dung hill. Then you never saw a hayfield over manured, so far as the growth is concerned. In the hay you want the stem and leaf, and in the turnip, and mangel, and carrot you want the root; therefore manuring is the right thing for them. Beside their period of growth and accumulation extends many weeks after the period of collection by ripening cereals has ended, and that at a time when the farmyard manure applied that season is most readily available, and when nitrification in the soil is most active.

There is a fundamental principle to guide in making a rotation of crops: apply manure for green crops and hay, and follow these by cereals sown in soil having a very fine tilth, since for them there is only a short growing season. That the early first part of it should be favorable is most important for the yield of grain.

Application of farmyard manure directly for grain crops is often a wasteful practice, but put on for root or other green crops it puts and leaves the soil in the best condition for grain crops to follow. I do not contend for sowing grain on poor land, but for putting manure on for green crops and for grass and for hay, which take all the nourishment they require, and leave enough, and that in the best condition, for the growth of the succeeding crop of grain.

SEED GRAIN.

I have spoken of the availability of plant food in the soil, and the making of it more so by cultivation and a rotation of crops. I want to speak also of the power of the plant to take these things out of the soil and the air — the inherited power of the plant. A plant has inherited its initial vital power from all the crops through which it came — all the ancestors through which it ascended or descended. An appreciation of the inherited as well as the acquired power of plants will be of assistance in selecting the kind of seed that will do best on each farmer's land. What I want to make clear is the difference in the vigor of growth between seeds of the same variety when sown in different localities, and the difference — the amazing difference — in the productiveness of selected large plump seeds over small seeds of the same variety.

The seed of a cereal is a plant in embryo, and a store of food for the nourishment of the young plant after it wakens into activity (germinates), and until it takes in food through its rootlets and leaves. The germination of the seed is not the so-called creation of life. That happened when the plant was fertilized; and the seed is an embryo, with a store of food lying close by it and within the same skin. The store of food which composes the greater part of the seed is for the maintenance of the young plant until it is able to take enough nourishment through its leaves and rootlets. A young plant is wakened up as soon as the moisture and warmth are sufficient, and its food close by is prepared under the same conditions.

Sometimes an embryo plant is imperfectly formed and weak; and tests show that imperfectly ripened seeds, under ordinary conditions, do not give nearly as good a crop as fully ripened seeds in each of which both the embryo and its food have been fully prepared. Those seeds which germinate most quickly are the best, and it has been proved over and over again that heavy seeds give larger and better crops than small seeds of the same sort. The reason seems to be that in one case (large seeds), the supply of food for the young plant is plentiful when it most needs it, while in the other case (small seeds), the food supply may be insufficient to nourish the young plant adequately at the most critical time when it is tender and struggling for survival. Under the most favorable conditions of temperature, moisture, and food supply in the soil, small seeds might give as much in crop as large seeds. On comparatively poor land, in unfavorable seasons, is where the small seeds give their worst returns. The farmer who has rich soil in a fine condition of tilth is the only one who can afford to sow small seeds, and the risk of comparatively small crops is great even then.

The following quotation from an article in the Year Book of the United States Department of Agriculture for 1898, shows what may be expected from a careful system of selection of seed grain from the most vigorous and most productive plants in any plot or field, when that is followed up with intelligence from year to year:

SHOWING EFFECT OF SELECTION.

"Selection is one of the most important factors in plant breeding, the natural capacity of all plants to vary furnishing the basis on which the breeder has to work."

"The largest ears may grow on comparatively unproductive or weak stalks, and, therefore, to obtain the best results seed corn *should be selected in the field,* and attention given to the habit, productiveness, general vigor, etc., of the plant, as well as to the character of the ear, kernel and cob, and uniformity in ripening. The same remarks apply to the selection of seed wheat."

"Allen cites an interesting case of increased yield in corn as a result of selection, as follows: 'Four years ago my foreman, at my earnest request, began the selection of field corn for seed purposes. He grew the white dent red-cob variety. Before harvesting the main crop he went over the field and selected the lowest growing, stocky stalks, with two perfect ears each. He has followed the same plan ever since, with *an increase of fully* 25 *per cent. in productiveness.*'"

SUCCULENT FEED FOR CATTLE.

Beside these matters connected with the management of the soil and plants, great progress has also been made by dairy farmers in choosing the sorts of crops and the areas of each to be planted. It is now generally recognized that crops for dairy cattle must not only be nutritious but succulent also. The growth and feeding of turnips to horned cattle has been contemporaneous with their improvement in nearly all countries; and turnips appear to supply the form of succulent feed during the winter months, which brings about the best development of constitutional vigor. The feeding of turnips to milch cows during their dry periods is advantageous in every sense. However, I do not wish to be understood at all as advocating the feeding of turnips to milking cows when succulent feed of quite as economical and more suitable nature, such as mangels, carrots, Indian corn ensilage and others, can be obtained. For milking cows in stables the following may be taken as a sort of standard ration for economy and efficiency. Of course, it would have to be modified according to local conditions of soil, climate, cattle and products wanted by each individual farmer. I put it forward more as being suggestive than as being one to be copied into everybody's practice.

Fifty pounds Indian corn ensilage; 50 pounds mangels; 5 pounds hay; 5 pounds oat straw; and from 3 to 9 pounds of meal or other form of concentrated feed, according to capacity of the individual cow and stage of lactation at the time. It does not often pay to feed a milking cow a heavy ration of grain after the seventh month of her milking period. As a rule, that part of the ration may with advantage be greatly reduced from that period onward.

CARE OF CATTLE.

Some of the more important points to be observed in the care of dairy cattle are those concerned with the housing of the cattle in a country like Canada where the climatic conditions require the stabling of cattle on an average for perhaps six months of the year. It is a good plan to have the inside of the cow stable whitewashed twice every year. That, beside being a cleaning process, makes the interior of the stable lighter; and plenty of sunlight is a great promoter of health. The stable conditions throughout should make for the comfort of the animals. Comfort is a necessary experience on the part of the cow if she is to yield the largest possible profit. I have no occasion to go into this matter at length, as it is being treated of at this convention more fully by others. In passing, let me remark that in the breeding of dairy cattle, the object should be continuously toward the development of the form and temperament which the dairy farmer considers to be most suitable for his dairy business. I do not hold that it is necessary to stick to one breed; but the crossing of breeds of different types of body and different types of temperament is seldom profitable, and is usually carried out at a loss — a loss of the best qualities of both of the breeds. Progress is made in the productive ability for either beef or dairy products only when the breeding is carried on in a direction toward a definite type for a definite purpose.

CARE OF DAIRY PRODUCTS.

Great progress is being made in the methods by which dairy products are taken care of. It does not follow that they are now taken care of in such a way as to be always in better condition than formerly. But if better care were not taken of the milk and the butter, and of the cheese nowadays, than was general twenty-five years ago, all of them would be very much injured indeed. Conditions of atmosphere and all the rest of it are very much less suitable for preservation than formerly. I have already hinted of the greatly-increased forms of bacterial life which attack dairy products at all times and in all places. When ordinary cleanliness has been observed in the care of milk, it is still necessary that it should be kept continuously under 70°, if the best results are to be obtained from it in the making of butter and the making of cheese.

BUTTER-MAKING.

The ripening of cream for butter-making is now recognized as being almost wholly a process of fermentation. To obtain fermentation of the right sort many butter-makers pasteurize the cream, and then put in what is called a "fermentation starter." The fermentation, which is beneficial to cream for butter-making, becomes deleterious to butter if it be continued when the product has reached that stage. Consequently, after the butter is made, unless to be consumed immediately, what is really needed is some form of "fermentation *stopper*" to put an end to the action of the fermentation starter. In saying this, I do not advocate the use of any preservative or other nostrum for the preservation of butter. If the butter be put in a cold room with the temperature under 36° F., fermentation will be practically stopped. If butter is to be kept for a considerable period of time, it should be kept in a room at a temperature near 20° F.

The provision of cold storage at creameries, on railways and on ocean steamships has been one of the means for very great improvement and development of the creamery business. Occasionally the paper linings of butter packages have been found affected by spots of mould. When that occurs it is most objectionable, and lessens the value of butter. When such paper linings have been soaked for twenty-four hours in a strong solution of salt, to which about one ounce of formalin has been added to three gallons of brine, the appearance of the mould on these butter linings has been entirely prevented.

IMPROVEMENT OF CURING-ROOMS.

The curing-room should be so constructed and managed as to permit the temperature to be maintained in it continously at about 65°.

Flavor and body are the two qualities which determine the relative market price of cheese. The character of these qualities in Cheddar cheese is largely determined by the process of curing. There is still some doubt as to what is the agent which causes the curing of cheese, and thus makes the curd partly soluble and the body of the cheese rich and plastic. While the nature of the agent or agents is still a matter of speculation rather than of exact knowledge, the conditions under which the curing can be carried on successfully are fairly well understood. So far as curing develops the flavor of cheese, the agents in that change are doubtless minute forms of life known under the name of bacteria. The temperature at which the cheeses are kept affects the action of those minute forms of life, and through that determines in a large measure the flavor, the body and the texture which are produced in them.

CURING AFFECTS QUALITY.

A fairly steady temperature between 60° and 65° F., gives the best results. At that temperature, loss in weight by the shrinkage of the cheese, is also considerably less than at higher points. A dry atmosphere causes the cheese to lose in weight by the evaporation of the moisture, and may also cause small checks or cracks on the surface, particularly when the cheeses are new. The curing-rooms at the cheese factories in Canada are generally faulty in construction; and it is very difficult, if not wholly impracticable, to regulate the temperature in them at 65° or thereabouts. Irregularity of temperature causes many of the faults complained of by the cheese exporters and also by the receivers of cheese in Great Britain. If the temperature goes down to or below 50°, the cheese buyers complain of bitterness in the flavor. If the temperature goes as high as 70° or over, the cheese buyers complain of a heated flavor, or worse still, of a condition which is called "off-flavored."

WRONG METHODS.

The methods of managing the curing-room have been too much after the following fashion:

1. In the spring of the year a stove is used to heat the room; too often it is not screened or placed in such a way as to cause a circulation of air; the cheeses in the vicinity of the stove are overheated, and those in the other parts of the room are left too cold.

2. In the warm weather of summer, the cheese-maker opens the windows and sometimes the door of the curing-room at night, and shuts them in the morning. The average curing-room is so conditioned by the genius of the builder and the frolics of time, that the closing of the doors and the shutters over the windows during the daytime, does not require all the pure fresh air to remain outside. It leaves the cheeses to be cured in the dark continuously, and that is not wholesome.

3 In the cool weather of autumn, a stove is generally used in the curing-room, without any provision being made for causing the heated air to circulate evenly through every part of the room. Consequently the cheeses on the shelves near the stove are often kept at a temperature of 80°, while the cheeses in the parts remote from the stove, are perhaps at a temperature of 50°.

IMPROVEMENT BY INSULATION.

The curing-room should be an insulated room, so constructed that the outside temperature would not necessarily affect its contents. For this purpose insulation means the construction of the walls, floor, and ceiling of the room in such a way that heat will not go through readily. For the storage of butter, the walls of the room should be so insulated that the temperature inside will not be more than 34°, even when it is as high as 98° in the open air. It is not necessary that the insulation of a cheese curing-room should be so thorough; but it should be sufficient to permit the temperature to be kept at or under 65°.

For the improvement of an old curing-room of the ordinary open construction, the following method may be adopted with good results. The whole inside should be thoroughly cleansed by a liberal use of boiling water. It should be disinfected by washing with hot water, to which one pound of carbolic acid to ten pounds of water has been added. It should then be whitewashed with fresh-slaked lime. To make the old floor close, it will usually be necessary to put two thicknesses of building paper over it, and a new floor laid on top of the paper. If the inside walls of the old curing-room are of lumber or plaster, two thicknesses of building paper may be put on, and over them one thickness of matched lumber, dressed on at least one side. The ceiling should be made close in a similar way. The windows should be made close, and double doors and windows should be put on for use in summer as well as during the late autumn and winter. A coating of whitewash should be applied to the walls.

These improvements in a curing-room 30 feet by 20 feet would cost probably $220 for material and labor, according to the condition of the room and the price of lumber, labor, etc., in the locality; $50 for double doors, windows and ventilator, and $80 for a sub-earth duct. At a factory turning out about 300 large cheeses per month, such a curing-room might be so used as to avoid some of the shrinkage in weight which would occur in an ordinary curing-room where the thermometer fluctuated between 70 and 90 degrees. The saving might be one pound per cheese. The injury to the flavor and body of the cheese from overheating and chilling might also in a great measure be prevented. The extra value which might be realized out of the cheese from the diminished shrinkage and superior quality would likely be not less than $450 during the season. Besides, great and lasting benefit would result to the cheese trade, if all the cheeses of Canada were cured in a proper way. The demand from the consumers in Great Britain would be increased, and the risk of loss to the merchants would be decreased.

VENTILATION AND MOISTURE.

In a room of which the walls are close, and otherwise well-constructed, the curing of the cheese will raise the temperature. Each cheese, by the fermentation going on during its curing, acts somewhat like a small slow-burning stove. There must be some means of cooling the room.

The average cheese curing-room is too dry. During hot weather, the floor should be sprinkled with water once or twice a day, certainly every morning. The evaporation of the water cools and moistens the atmosphere to the improvement of the cheese.

A cheap and effective means of cooling, and at the same time, ventilating a curing-room, is to use a sub-earth air duct. The duct or drain may be brought in through the floor of the room in two places It should be not less than 100 feet long, should be four feet deep, and have an opening for the passage of air of about ten inches square for every 5,000 cubic feet of room. It should be made of tiles. A good method is to put rows of tiles parallel to each other with two inches of earth between the rows in the same duct or drain. An upright opening at the far end, with a hood to be turned to the wind, is an advantage. In summer, such a sub-earth air duct can be used to reduce the temperature in the curing-room from ten to fifteen degrees, if the floors, walls, windows and doors are reasonably close.

INVESTIGATIONS ON CURING.

The Dominion Department of Agriculture has conducted experiments with the cheese of one factory for the seasons of 1899 and 1900. The cheese, last season, were divided after they left the pressroom, a proportion being put into a curing-room in which the temperature was kept continuously under 65° F., and a portion was put in an ordinary well-constructed curing-room. In 1900 the cheese were divided into three lots, one lot being put in a curing-room where the temperature was kept continuously under 65°, a second lot being put in an ordinary well-constructed curing-room, and a third lot being put in a curing-room similar to those in the most poorly equipped factories; it was simply a loft over the cheese-making room.

The following is the report of a committee of the Cheese and Butter Association, at Montreal, which was appointed for each of the two years to examine the cheese and report on their quality. The three or four cheese, as the case might be, from the controlled curing-room were placed right opposite to the corresponding three or four from the uncontrolled curing-room. The cheese had been kept in these curing-rooms until they were about three weeks old, when they were shipped to a cold-storage warehouse. They were kept in it at a temperature of about 38° F. until they were examined:

"At a recent meeting of the Butter and Cheese Association, which was called at the request of the Dairy Commissioner, we, the undersigned, were appointed a committee to inspect several lots of cheese, half of which we were informed had been cured at a temperature of not exceeding 65°, the remainder being cured in the ordinary curing-room. In company with the commissioner we inspected some thirty-one lots, and we found those cheese cured at a temperature of not exceeding 65° were very much superior in quality to those cured in the ordinary way, the difference in quality in most instances being most marked. Those cured at the lower temperature were better bodied, more silky in texture, and much milder in flavor, beside retaining their moisture better than those cured in the ordinary way. As a merchantable article we consider those cured at the lower temperature are worth fully one-half cent per pound more in price than those cured in the ordinary way. In view therefore of the marked superiority in quality shown in those cheese, that were cured at the lower temperature, we advise that the government be urged to impress upon the cheese factories the desirability of seeing that their curing-rooms are kept at a temperature of not exceeding 65° F., and that the factory men should also be informed of the length of time required to cure cheese at the lower temperature. A detailed report is herewith annexed.

"ARTHUR HODGSON,
President.
"JNO. McKERGOW,
"D. A. McPHERSON,
"ALFRED J. BRICE,
"P. W. McLAGAN."

That presents the substance of the whole question. The cheese cured under these conditions of controlled temperature, continuously under 65° F., are of better quality, better flavor and are worth a half a cent per pound more than the others cured in an ordinary curing-room in which the temperature was sometimes between 70° and 80° F."

REPORT OF COMMITTEE.

We, the undersigned committee of the Montreal Butter and Cheese Association, appointed for the purpose of examining and reporting upon the relative commercial value of several lots of cheese cured at different temperatures, under the direction of the Commissioner of Agriculture and Dairying, beg to report as follows:

1. That we have fully examined the different lots, and made careful comparisons as to their values upon an actual commercial basis.

2. That the following table gives the general conclusions of the committee. If finest cheese are value at 10 cents, then the figures placed under the lots cured in different ways indicate the relative value:

	Lot 1. Controlled.	Lot 2. Good, ordinary.	Lot 3. Poor, ordinary.
June cheese	10¢ per lb.	9½¢ per lb.	9¢ per lb.
July cheese	10¢ per lb.	9½¢ per lb.	9¼¢ per lb.

3. The committee would add that the lots marked No. 1 have a cleaner, milder flavor, and show a more silky, waxy body.

MONTREAL, *November* 7, 1900.

(Signed) JAS. ALEXANDER,
" M. J. FARRELL,
" A. C. WIELAND,
" ALEX. W. GRANT.

WATCHING TRANSPORTATION.

During the past season, the Department of Agriculture had one man stationed at Montreal who was an official referee on the quality of cheese and butter. When a dispute arose between a salesman and a buyer regarding the quality of any lot of cheese or butter, the official referee might be called in to give his decision on the quality. He also wrote to the salesman or manufacturer, pointing out what, in his judgment, would be a means of remedy in the case of any defects he had observed. This work was done during the past summer by Mr. J. A. Ruddick, and his services in that capacity have been eminently useful and satisfactory.

The department also had one man stationed at Montreal during part of the season to observe the condition in which cheese and butter were handled in loading the steamships. Taking seven comparatively small lots of cheese as an instance from one of his reports, the following is a statement of their condition as delivered on the wharf:

Of 786 boxes of cheese, 101 were in a broken condition, but had been coopered, mostly by being tied with strings. Eighty-five were broken and not coopered. That showed a total of 186 boxes in a partially damaged condition, or 23 per cent. of the whole lot.

AGENTS IN GREAT BRITAIN.

Agents of the Department of Agriculture were stationed during the past season at the ports of London, Bristol, Liverpool, Manchester and Glasgow. They were instructed to report on the condition in which Canadian cargoes were delivered from the steamships, and to observe the manner in which they were handled from the steamships to the warehouses, or to the railway cars. The reports which they furnished were submitted to the owners or agents of the steamships, on the Canadian side, and have already led to very great improvement in the manner in which Canadian products are stowed in the steamships, and the manner in which they are handled both in the loading and discharging of the cargoes. However, these reports from our agents in Great Britain show that, in many cases, cheese were delivered from the steamships with as much as 50 per cent. of the boxes in a broken condition. Some of the reports say the boxes were too large for the cheese, that they had ill-fitting covers; that they were made of poor material, particularly the bands of the boxes; that they were not well nailed; that they were not clearly marked; that some were dirty, and that in not a few instances cheese were delivered in a heated condition. All these things call for improvement and for remedies. I am authorized by the Minister of Agriculture to intimate that if dairymen will take the necessary steps to protect the cheese in the curing-rooms at a temperature under 65° F., so as to turn out the best quality in flavor and body through proper curing, he will do his best to arrange with the railway companies to provide more suitable cars for the carriage of cheese to the seaboard, and also see that steamship companies provide forced ventilation of holds in which cheese and other perishable products are carried, by means of ventilators and fans. It is most important for the dairy business that immediate attention should be given to these matters. The matter of paying one or two cents more per box to obtain a strong, well-made, well-nailed, close-fitting box, of good sound lumber is a small matter compared with the increased value which such a package would give to its contents in the British market.

There are many other matters which should also be mentioned in an address which has even such a title as "The Progress of Dairying in Canada," which time will not permit me even to allude to. But I am authorized by the honorable the Minister of Agriculture to say that our department is looking toward the extending of its usefulness in the directions where dairymen still need the most help. Men will again be sent to Great Britain to observe the conditions of the markets, to learn the latest preferences there, and to observe the methods of delivering food products from the steamships. Our office will also, so far as possible, interpret the commercial criticism of the buyers in Great Britain into helpful information for the producers in Canada.

We can only hope to keep our place in the markets and to make any gain, by the superiority of our products, the regularity of their shipment, by having them put up in the nicest and most attractive form, and by ability to sell them as low as any of our competitors, and still have a living profit for ourselves. These results can be obtained again in proportion as the dairy farmers make further progress in intelligence, practicability, and a desire and capacity to work together for the good of all.

So I end my address as I began it, by commending these to your most thoughtful and kindly consideration.